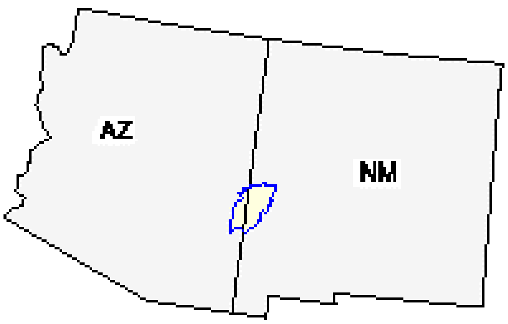
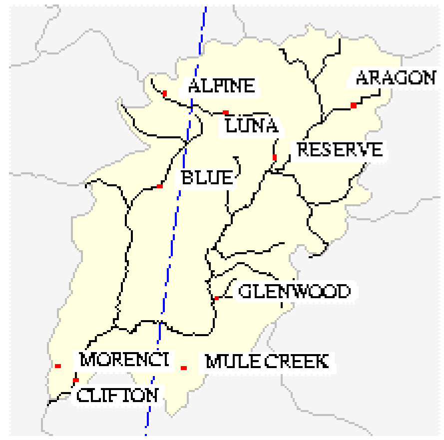
DRAFT

TOTAL MAXIMUM DAILY LOAD FOR PLANT NUTRIENTS ON CENTERFIRE CREEK





Summary Table

New Mexico Standards Segment	San Francisco River Basin, 20.6.4.603, (formerly 2603)
Waterbody Identifier	Centerfire Creek from the mouth on the San Francisco River to the headwaters, 7.1 mi.
Parameters of Concern	Plant Nutrients
Uses Affected	High Quality Coldwater Fishery
Geographic Location	San Francisco River Basin (SFR4-30300)
Scope/size of Watershed	136 mi^2 (Centerfire Creek drainage area)
Land Type	Ecoregion: Arizona/New Mexico Mountains
Land Use/Cover	Forest (75%), Rangeland (25%), Wetlands (<1%)
Identified Sources	Rangeland, Removal of Riparian Vegetation, Streambank Destabilization
Watershed Ownership	Forest Service (90%), Private (10%)
Priority Ranking	4
Threatened and Endangered Species	None
TMDL for: Plant Nutrients (Algal Growth/Chlorophyll)	WLA + LA + MOS = TMDL **0 + 2.64 + 0.47 = 3.11 lbs/day**

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List of Abbreviations

BMP	best management practice
CFS	cubic feet per second
CMS	cubic meters per second
CWA	Clean Water Act
CWAP	Clean Water Action Plan
CWF	Coldwater fishery
EDTA	ethylenediaminetetra-acetic acid
EPA	Environmental Protection Agency
FS	United States Forest Service
HQCWF	High quality coldwater fishery
LA	load allocation
MGD	million gallons per day
mg/L	milligrams per liter
MOS	margin of safety
MOU	memorandum of understanding
NMED	New Mexico Environment Department
NPDES	national pollution discharge elimination system
NPS	nonpoint sources
RBP	Rapid Bioassessment Protocol
SOP	Standard Operating Procedure
SWQB	Surface Water Quality Bureau
TMDL	total maximum daily load
UNM	University of New Mexico
USGS	United States Geological Survey
UWA	Unified Watershed Assessment
WLA	waste load allocation
WQLS	water quality limited segment
WQCC	New Mexico Water Quality Control Commission
WQS	water quality standards

EXECUTIVE SUMMARY

Centerfire Creek North of Spur Ranch Project

Section 303(d) of the Federal Clean Water Act requires states to develop TMDL management plans for water bodies determined to be water quality limited. A TMDL documents the amount of a pollutant a water body can assimilate without violating a state's water quality standards. It also allocates that load capacity to known point sources and nonpoint sources at a given flow. TMDLs are defined in 40 CFR Part 130 as the sum of the individual Waste Load Allocations (WLA) for point sources and Load Allocations (LA) for nonpoint sources, including a margin of safety (MOS), and natural background conditions.

San Francisco River watershed stations were located throughout the San Francisco watershed basin to evaluate the impact of tributary streams and to establish background conditions. As a result of this monitoring effort, several exceedances of New Mexico water quality standards for plant nutrients were documented on Centerfire Creek from the mouth on the San Francisco River to its headwaters (SFR4-30300, 7.1 mi.). A limiting nutrient and algal biomass for Centerfire Creek determined moderately high productivity levels for algae in June and July of 2001 (Appendix E). This Total Maximum Daily Load (TMDL) document addresses plant nutrients. A TMDL for conductivity was also developed for this reach. This reach has a priority 4 ranking by the State of New Mexico.

This segment of Centerfire Creek is in standards segment 20.6.4.603 NMAC (formerly 2603) of the San Francisco River Basin. Segment 20.6.4.603 includes all perennial reaches of tributaries to the San Francisco River at or above the town of Glenwood. Designated uses include domestic water supply, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat and secondary contact. Use not fully supporting due to excess plant nutrients (algal growth) is high quality coldwater fishery.

A general implementation plan for activities to be established in the watershed is included in this document. The Surface Water Quality Bureau's Watershed Protection Section (SWQB/WPS) will further develop the details of this plan. Implementation of recommendations in this document will be done with full participation of all interested and affected parties. During implementation, additional water quality data may be generated. As a result targets will be re-examined and potentially revised; this document is considered to be an evolving management plan. In the event that new data indicate that the targets used in this analysis are not appropriate or if new standards are adopted, the load capacity will be adjusted accordingly. When water quality standards have been achieved, the reach will be removed from the 303(d) list.

Background Information

The Gila-San Francisco River Watershed covers an area in New Mexico of over 6,000 mi^2. The San Francisco River, the major tributary of the Gila system in New Mexico, originates in eastern Arizona from the Mogollon rim south of Alpine and from the Colorado Plateau and isolated volcanic mountain ranges to the north. The San Francisco River enters New Mexico and flows in a ninety-mile arc through the Apache and Gila National Forests before re-entering Arizona. The San Francisco River from the confluence with Centerfire Creek to the New Mexico Arizona Border is located in southwestern New Mexico. The river enters New Mexico west of the town of Luna, in Catron County, and flows east southeast for approximately 15 miles before confluencing with Centerfire Creek.

Centerfire Creek North of Spur Ranch Project

The Centerfire Creek watershed is approximately 136 mi^2. Land use/cover consists of 75% forest, 25% rangeland, and <1% wetland (Figure 1). The Forest Service has jurisdiction over 90% of this area while the other 10% is privately owned (Figure 2).

Endpoint Identification

Target Loading Capacity

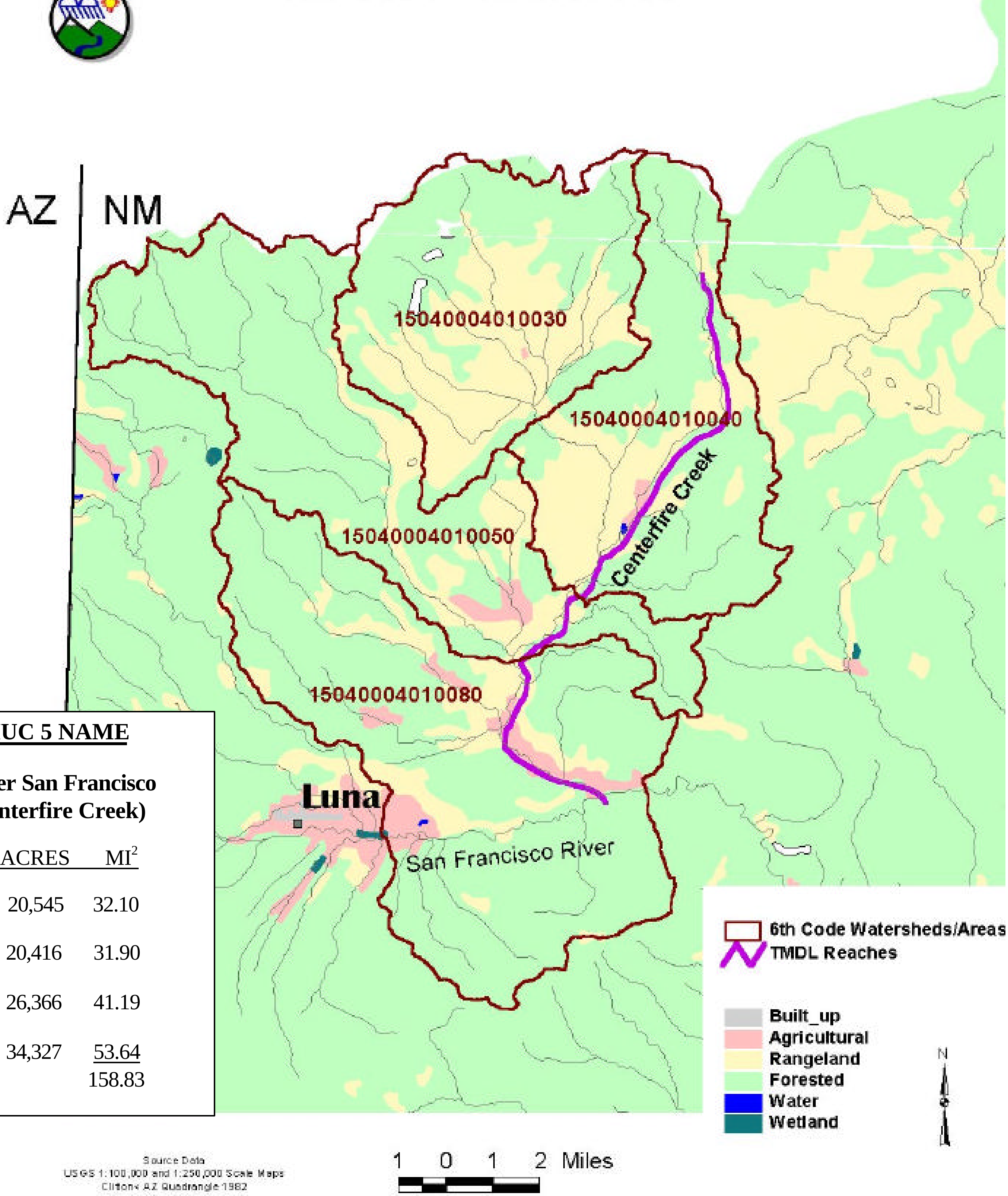
Overall, the target values are determined based on 1) the presence of numeric and narrative criteria, 2) the degree of experience in applying the indicator and 3) the ability to easily monitor and produce quantifiable and reproducible results. For this TMDL document the target value for plant nutrients is based on numeric and narrative criteria. This TMDL is consistent with the State antidegradation policy.

Plant Nutrients

The New Mexico Water Quality Control Commission (WQCC) has adopted narrative water quality standards for plant nutrients to sustain and protect existing or attainable uses of the surface waters of the state. This general standard applies to surface waters of the state at all times, unless a specified standard is provided elsewhere. These water quality standards have been set at a level to protect coldwater aquatic life. The high quality coldwater fishery (HQCWF) use designation requires that a stream have water quality, streambed characteristics, and other attributes of habitat sufficient to protect and maintain a HQCWF. The plant nutrient standard leading to an assessment of use impairment is as follows.

Figure 1

Upper San Francisco River Basin
Land Use/Cover
6th Code Watersheds

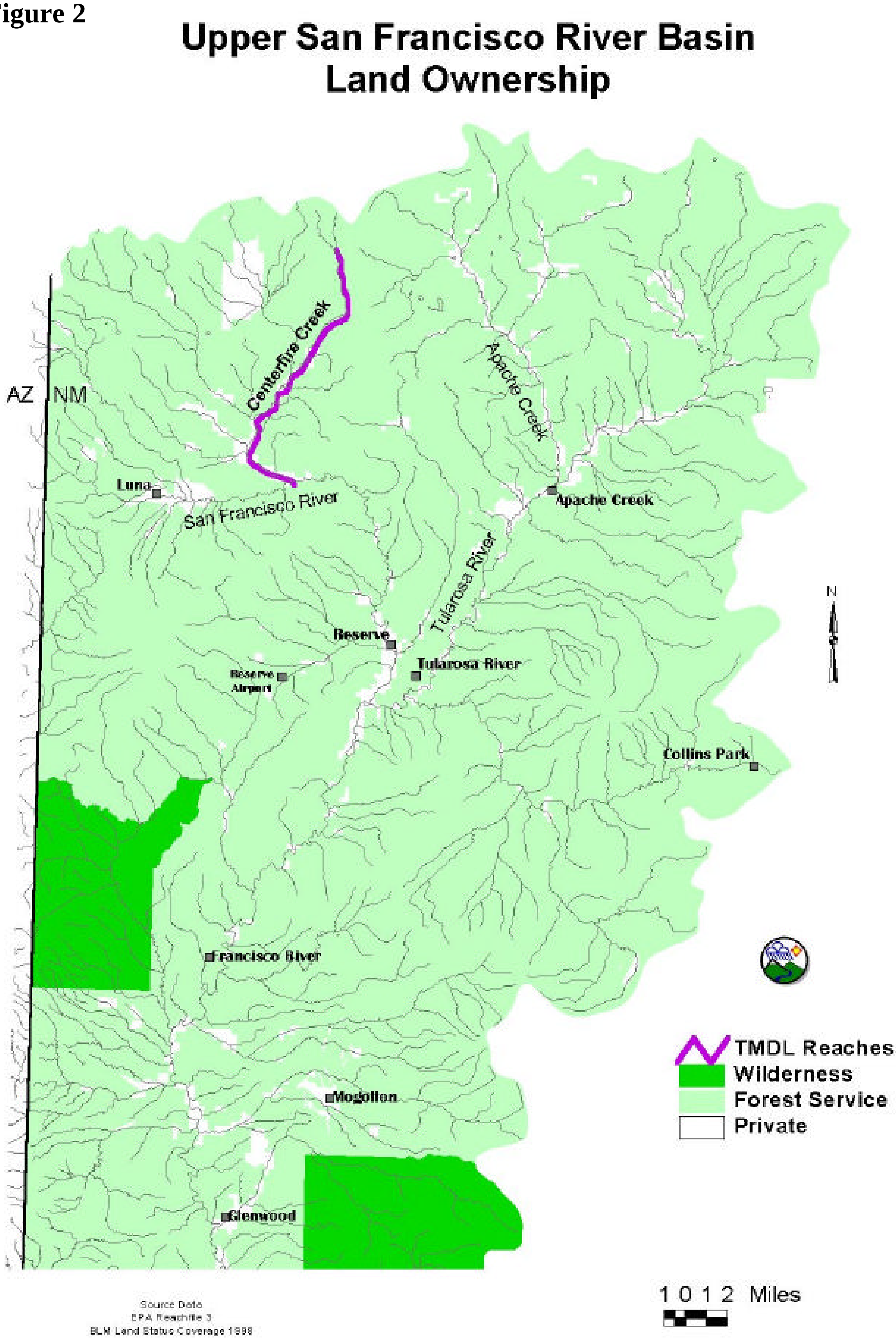


HUC 5 NAME

Upper San Francisco (Centerfire Creek)

HUC	ACRES	MI^2
4010030	20,545	32.10
4010040	20,416	31.90
4010050	26,366	41.19
4010080	34,327	53.64
		158.83

Figure 2



Upper San Francisco River Basin
Land Ownership
AZ
NM
Centerfire Creek
Apache Creek
Luna
San Francisco River
Apache Creek
Tularosa River
Reserve
Tularosa River
Reserve Airport
Collins Park
N
Francisco River
TMDL Reaches
Wilderness
Forest Service
Private
Mogollon
Glenwood
1 0 1 2 Miles
Source Data
EPA Reachfile 3
BLM Land Status Coverage 1998

Plant nutrients from other than natural causes shall not be present in concentrations, which will produce undesirable aquatic life or result in the dominance of nuisance species in surface waters of the state.

Centerfire Creek is listed on the 2000-2002 NM 303(d) list of waters not meeting water quality standards, based on the presence of plant nutrients resulting in nuisance growths of algae. This reach was originally listed for plant nutrients based on 1992 data. This determination was based on the best professional judgment of the principal investigator during the 1992 intensive survey.

Plant Nutrient Assessment

View of the below-mentioned Sonde deployed to measure multiple parameters every 15 minutes at this station.

Since there are no numeric standards applicable to Centerfire Creek for plant nutrients, an assessment for nutrient enrichment was made in the spring and summer 2001. This survey was conducted during high and low flow events in Centerfire Creek. The plant nutrient assessment determined there was extensive filamentous algae and some macrophyte growths in the creek. There also appeared to be filamentous algae covering the gravel substrata (Appendix F).

Additional water quality was collected for nutrients, ions, macroinvertebrates (using EPA's Rapid Bioassessment Protocols, RBP) and an algal bioassay was performed (Appendices D and E). As well, a data-collecting YSI ® multi-parameter water analysis probe was deployed in Centerfire Creek from March 6-14, 2001, May 8-18, 2001, and from June 21-28, 2001 (Appendix B). This probe was programmed to record temperature, dissolved oxygen, conductivity, and pH every fifteen minutes over the time periods Large diurnal fluctuations in dissolved oxygen or pH could be indicative of possible nutrient enrichment in the stream. Several pH values in March, May and June 2001 appear to be elevated above 8.5 possibly indicating elevated levels of plant productivity in the stream (Appendix B).

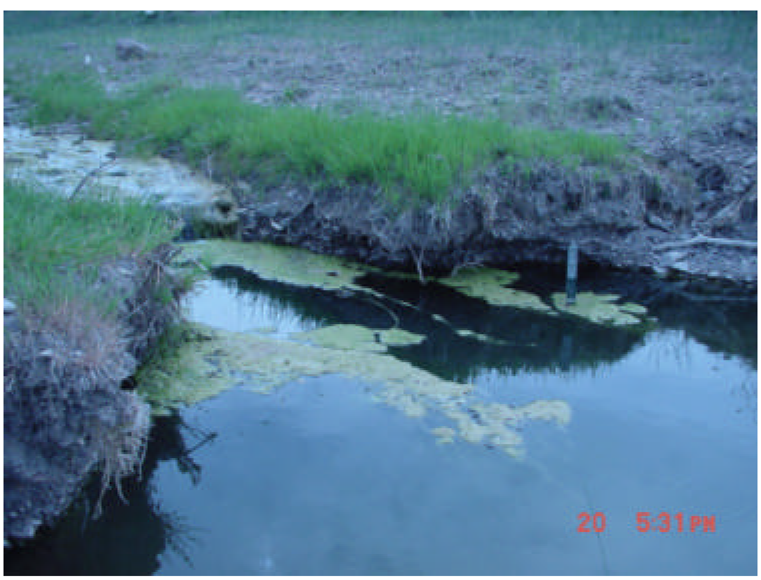
Algae reduce the levels of dissolved oxygen in the river during the early hours of the morning as a result of respiration. This reduction of dissolved oxygen can be a limiting factor for aquatic communities in Centerfire Creek. The algae also increase dissolved oxygen above saturation during warm, sunny afternoons. These supersaturated levels could be harmful to fish in some instances causing gas-bubble disease in fish. Plants and algae also consume carbon dioxide which causes pH to rise. When algae and plants die, bacterial action promotes decay and nutrients are released either back into the water column or into the sediments. Nitrogen released

during decomposition produces ammonia, and the amount of ammonia that is converted to the toxic unionized form is directly related to pH.
Historic and current fish and benthic data from various government agencies was also researched to determine any biological impairment in the stream.

Algal Bioassay

There were no tests or models available to predict the combined effects of both macrophyte and algae interactions on nutrient cycles and water quality in streams or lakes. Macrophytes compete with algae for light, so as their density and canopy height increases during the summer they inhibit algae growth. However, from the nutrient assessment on Centerfire Creek there appeared to be more algae present in the stream than macrophyte growths (Appendix F). Therefore, an algal bioassay was performed for Centerfire Creek. There are two potential contributors to nutrient enrichment, excessive nitrogen and phosphorus. In order to determine which of these two nutrients is limiting, an algal growth test was performed by the University of New Mexico (UNM) Department of Biology researchers (Appendix E). Laboratory analysis of ambient waters determined the water is slightly limiting in nitrogen. When 0.25 mg/L is added, the growth is stimulated; however further additions of nitrogen do not stimulate algal growth.

Looking downstream at excessive aquatic vegetation in Centerfire Creek below the Spur Ranch Project.



Pool at the Centerfire Creek sampling station. Note the decreased flow, sonde and aquatic "mats" on the waters surface.

This indicates that something other than nitrogen becomes limiting. A slight limitation of phosphorus is also noted, and additions of 0.01 and 0.025 mg P/L stimulates growth. However, further additions of phosphorus did not increase growth (Appendix E). Algal growth was measured by the UNM researchers by fluorescence measurements, and converted to algal dry weight by experimentally establishing a relationship between fluorescence and algal dry weight.

Various concentrations of N (as nitrate) and P (as phosphate), ethylenediaminetetra-acetic acid (EDTA), and Iron (Fe as Fe III-EDTA) were added to the water samples from Centerfire Creek along with *Selanastrum capricornutum* (Appendix E). The water samples from Centerfire Creek collected in June 2001 displayed significant algal growth without any additions of phosphorus and nitrogen. Addition of EDTA did not stimulate growth, thereby indicating the absence of metal toxicity (Appendix E).

The algal bioassay for Centerfire Creek provides a summary of algal growth in the bioassay when no additions of nutrients were made (Appendix E). However, this test determined that without any added nitrogen or phosphorus to the water sample, the algal biomass in Centerfire Creek was moderately high in productivity, indicating a current plant nutrient and algal growth problem. A specific numeric nitrogen or phosphorous value which could indicate a level at which problematic algal growths in Centerfire Creek could occur, was not determined from the bioassay tests. There was already a significant algal growth problem occurring in Centerfire Creek and it was not possible to back-calculate to a level at which algal growth is not an issue.

Flow

The presence of plant nutrients in a stream can vary as a function of flow. As flow decreases, the concentration of plant nutrients can increase. Thus, a TMDL is calculated for each reach at a specific flow. The flow value used to calculate the TMDL for plant nutrients on Centerfire Creek was obtained using a 4-day, 3-year low-flow frequency (4Q3) regression model (Appendix C). The 4Q3 is the annual lowest 4 consecutive day period discharge that will not fall below that discharge at least every 3 years (USGS, 2001). This method of estimating low flows was developed for ungaged, unregulated streams in New Mexico. Centerfire Creek did not have a USGS gage on it.

It is important to remember that the TMDL is a planning tool to be used to achieve water quality standards. Since flows vary throughout the year in these systems the target load will vary based on the changing flow. Management of the load should set a goal at water quality standards attainment, not meeting the calculated target load.

Calculations

With respect to the plant nutrient problem in Centerfire Creek, it was not possible to estimate the amount of nitrogen and phosphorus that can be tolerated by Centerfire Creek without presenting a plant nutrient problem. Instead, the load calculations are based on algal growth. To address this, University of New Mexico (UNM) researchers relied on a 1978 EPA publication (Miller et al., 1978), which established four levels of productivity in surface waters. This publication is the most current paper known for productivity classification in surface waters based on algal bioassays. Centerfire Creek has current algal productivity values greater than the moderate productivity classification from Table 1 (Appendix E). The moderate productivity level for algal growth will be used in calculating the TMDL for plant nutrients (Table 1). As stated previously, an excessive amount of aquatic vegetation is not beneficial to most stream life. The level of nutrient enrichment is often reflected by the types and amounts of aquatic vegetation in the water. High levels of nutrients may promote an overabundance of algae and floating and rooted macrophytes. Centerfire Creek is already exhibiting moderately high productivity rates of algal growth.

Table 1. Productivity Classification Based on Algal Bioassays (Miller et al., 1978).

Algal Growth (mg dry weight/L)	Classification
0.00-0.10	Low productivity
0.11-0.80	**Moderate productivity**
0.81-6.00	Moderately high productivity
6.10-20.00	High productivity

This TMDL was developed based on simple dilution calculations using 4Q3 flow (Appendix C), and the EPA moderate level productivity criterion based on algal bioassays in mg dry weight (Table 1). The TMDL calculation includes wasteload allocations, load allocations, and a margin of safety.

Target loads for plant nutrients are calculated based on a low flow (4Q3), the average value of the moderate productivity algal plant growth (Table 1) (0.455 mg dry weight/L), and a unit-less conversion factor of 8.34, that is used to convert mg/L units to lbs/day (Appendix A Conversion Factor Derivation). The target loading capacity is calculated using Equation 1.

Equation 1. *critical flow (mgd) x moderate productivity value (mg/L) x 8.34 (conversion factor) = target loading capacity*

The target loads (TMDLs) predicted to attain standards were calculated using Equation 1 and are shown in Table 1.

Table 2: Calculation of Target Loads

Location	Flow* (mgd)	Moderate Level Productivity Criterion** (mg dry weight/L) Level**	Conversion Factor	Target Load Capacity (lbs/day)
Centerfire Creek	0.82	0.455	8.34	3.11

*Flow obtained using the 4Q3 regression model (USGS 2001) (Appendix C)
**From Table 1.Productivity Classification Based on Algal Bioassays (Miller et al., 1978)

Background loads were not possible to calculate in this sub-watershed. A reference reach, having similar stream channel morphology and flow, was not found. It is assumed that a portion of the load allocation is made up of natural background loads. In future water quality surveys, finding a suitable reference reach will be a priority.

The load reductions that would be necessary to meet the target loads were calculated to be the difference between the target load (Table 2) and the measured loads (Tables 2 and 3), and are shown in Table 4 (Calculation of Load Reductions).

The measured loads were calculated using Equation 1. The flows were derived based on the 4Q3 for Centerfire Creek (Appendix C).
The productivity of algae in Centerfire Creek when no additions of nitrogen or phosphorus were made in the bioassay are used in the calculation of the measured loads (Appendix E). Thus, the 3.7 mg dry weight/L from Centerfire Creek is substituted for the moderate productivity criterion from Table 1. This is a direct measurement from the stream water (Table 3). This calculation is based on the chlorophyll content and fluorescence measurements.

Table 3: Calculation of Measured Loads

Location	Flow* (mgd)	Lab Measure** Algal Growth (mg dry weight/L)	Conversion Factor	Measured Load (lbs/day)
Centerfire Creek	0.35	3.7	8.34	10.80

*Flow obtained using the 4Q3 regression model (USGS 2001)
**The actual lab measure for algal growth in Centerfire Creek (in mg dry weight/L).

Waste Load Allocations and Load Allocations

Waste Load Allocation

There are no point source contributions associated with this TMDL. The waste load allocation is zero.

Load Allocation

In order to calculate the Load Allocation (LA), the waste load allocation, background, and margin of safety (MOS) were subtracted from the target capacity (TMDL) following Equation 2.

Equation 2. $WLA + LA + MOS = TMDL$

Results are presented in Table 4 (Calculation of TMDL for Plant Nutrients mg dry weight/L).

Table 4: Calculation of TMDL for Plant Nutrients (mg dry weight/L).

Location	WLA (lbs/day)	LA (lbs/day)	MOS (15%) (lbs/day)	TMDL (lbs/day)
Centerfire Creek	0	2.64	0.47	3.11

The load reductions that would be necessary to meet the target loads were calculated to be the difference between the target load (Table 2) and the measured load (Table 3), and are shown in Table 5 (Calculation of Load Reductions).

Table 5: Calculation of Load Reductions

Location	Target Load	Measured Load	Load Reductions
Centerfire Creek	3.11	10.80	7.69

Identification and Description of Pollutant Source(s)

Pollutant Source Summary

Pollutant Sources (% from each)	**Magnitude** (WLA + LA + MOS)	**Location**	**Potential Sources**
Point: None	0	--------	
Nonpoint: (100%) Plant nutrients (mg/L)		Centerfire Creek	Rangeland, Removal of Riparian Vegetation, Streambank Destabilization

Linkage of Water Quality and Pollutant Sources

Where available data are incomplete or where the level of uncertainty in the characterization of sources is large, the recommended approach to TMDLs requires the development of allocations based on estimates utilizing the best available information. SWQB fieldwork includes an assessment of the potential sources of impairment (SWQB/NMED 2000a) and the Nutrient Assessment Protocol (Appendix F).

These protocols established by the SWQB include the Pollutant Source(s) Documentation Protocol (Appendix G), and the Nutrient Assessment Protocol (Appendix F).

To determine whether a reach is nutrient impaired and large enough to cause undesirable water quality changes, three levels of assessment are available in the Nutrient Assessment Protocol (Appendix F). Level one and two nutrient assessments were used on Centerfire Creek in 2001.

To provide more information for the Nutrient Assessment Protocol, SWQB staff collected additional water quality on Centerfire Creek from March 6-14, 2001, May 8-18, 2001, and from June 21-28, 2001 (Appendix B). These water quality surveys were collected during high and low flows. Macroinvertebrates using EPA's Rapid Bioassment Protocols (RBP) were also collected in 2001 by SWQB staff. Results indicated the benthic community was in full support of its designated uses, however, impacts were observed to the community.

The Hilsenhoff Biotic Index (HBI), using macroinvertebrates to determine organic enrichment in streams revealed that Centerfire Creek has good water quality with some organic pollution. The macroinvertebrate community structure was less than expected, the composition (species richness) was also less than expected due to loss of some intolerant forms. The percent contribution of tolerant forms had increased in the stream. The HBI measures overall pollution tolerance of the benthic community to the degree of organic pollution. Centerfire Creek had a score of 4.75 which indicated some organic pollution in the stream.

Fisheries data (1998) from the Quemado Ranger District indicate Centerfire Creek is a very productive, very small low gradient stream with Speckled dace (*Rhinichthys osculus)*, Longfin dace (*Agrosia chrysogaster*), and Desert Sucker (*Catostomus Clarkii)*.
Speckled dace inhabit shallow, rocky stream areas with aquatic vegetation, but has a low tolerance to reduced oxygen levels. Breeding fish need to clear gravels in the stream of periphyton and debris to build nests. Longfin dace, during low water levels can take refuge in moist detritus and algal mats in streams, and is somewhat tolerant to reduced oxygen levels. Desert Suckers are bottom dwelling species that have a low tolerance to reduced oxygen levels in streams.

Samples for nutrients and major ions were also collected for the nutrient assessment. Water samples for the limiting nutrient and algal bioassay were also collected on June 21, 2001. Results indicated that nutrient levels were not elevated (Appendix D).

Overall, the observational and quantitative data collected for the nutrient assessment (Level 1 and 2) for Centerfire Creek showed a violation of the narrative standard for plant nutrients, and indicated a water quality impairment (Appendix F). There were extensive amounts of macrophytes and filamentous algae in the stream. As well, there appeared to be large cut banks which may be contributing a lot of nutrients bound to sediment into the stream. Also, there did not appear to be a riparian corridor to decrease the amount of incident sunlight to the stream. Several data points for pH from the sondes deployed in March, May and June 2001 indicate possible high plant productivity in the stream. Afternoon pH values were greater than 8.5 which supports impairment (Appendix B).

The Pollutant Source(s) Documentation Protocol, shown as Appendix G, provides an approach for a visual analysis of a pollutant source along an impaired reach. Although this procedure is subjective, SWQB feels that it provides the best available information for the identification of potential sources of impairment in this watershed.

The Pollutant Source Summary identifies and quantifies potential sources of nonpoint source impairments along each reach as determined by field reconnaissance and assessment. A further explanation of the sources follows.

Centerfire Creek

Perennial portions of Centerfire Creek flow through an incised gully that is approximately sixteen feet deep, with vertical walls that break off and dump sediment into the creek. While the erosion likely began at the end of the 1800s as a result of drought and overgrazing, attempts during the 1930s and later to farm the area contributed to the erosion.

Cattle grazing in this watershed have been monitored; elk herds up to 200 head in size, graze the sub-watershed ranch and the riparian area intensely particularly during the spring. Cattle in the riparian area of Centerfire Creek may represent an important source of nutrient contributions. Animal waste in the stream or riparian area can directly impair water quality by increasing nutrient levels.

High seasonal flows have had impacts on the stream's geomorphology that has lead to widening of the channel and removal of riparian vegetation.

Margin of Safety (MOS)

TMDLs should reflect a margin of safety based on the uncertainty or variability in the data, the point and nonpoint source load estimates, and the modeling analysis. For this TMDL, there will be no margin of safety for point sources, since there are none. However, for the nonpoint sources the margin of safety for plant nutrients is estimated to be an addition of **15%** of the TMDL, excluding the background. This margin of safety incorporates several factors:

•*Errors in calculating NPS loads*

A level of uncertainty exists in sampling nonpoint sources of pollution. Techniques used for measuring plant nutrient concentrations (phosphorus and nitrogen) in stream water have a (±)10% precision (SWQB/NMED, 1999b). Accordingly, a conservative margin of safety increases the TMDL by **10%**.

•*Errors in calculating flow*

Flow estimates were based on the estimation of the 4Q3 for ungaged streams and compared to actual flows and cross-sectional information taken in the field. Techniques used for measuring the flow on Centerfire Creek water have a (±) 5% precision. Accordingly, a conservative margin of safety increases the TMDL by **5%**.

Consideration of Seasonal Variation

Data used in the calculation of this TMDL were collected during high and low flow seasons in order to ensure coverage of any potential seasonal variation in the system. A data-collecting YSI® sonde multi-parameter water analysis probe was deployed in Centerfire Creek from March 6-14, 2001, May 8-18, 2001, and from June 21-28, 2001. Low flow was chosen as the critical flow for Centerfire Creek as there is more potential to have higher concentrations of plant nutrients in the stream during summer and early fall. Also, during this time period, there is more potential to have higher water and air temperatures, decreased periods of scouring, and maximum solar gain.

Future Growth

Estimations of future growth are not anticipated to lead to a significant increase for plant nutrients that cannot be controlled with best management practice implementation in this watershed.

Monitoring Plan

Pursuant to Section 106(e)(1) of the Federal Clean Water Act, the SWQB has established appropriate monitoring methods, systems and procedures in order to compile and analyze data on the quality of the surface waters of New Mexico.

In accordance with the New Mexico Water Quality Act, the SWQB has developed and implemented a comprehensive water quality monitoring strategy for the surface waters of the State. The monitoring strategy establishes the methods of identifying and prioritizing water quality data needs, specifies procedures for acquiring and managing water quality data, and describes how these data are used to progress toward three basic monitoring objectives: to develop water quality-based controls, to evaluate the effectiveness of such controls and to conduct water quality assessments.

The SWQB utilizes a rotating basin system approach to water quality monitoring. In this system, a select number of watersheds are intensively monitored each year with an established return frequency of every five years.

The SWQB maintains current quality assurance and quality control plans to cover all monitoring activities. This document, "Quality Assurance Project Plan for Water Quality Management Programs" (QAPP) is updated annually.

Current priorities for monitoring in the SWQB are driven by the 303(d) list of streams requiring TMDLs. Short-term efforts will be directed toward those waters which are on the EPA TMDL consent decree (Forest Guardians and Southwest Environmental Center v. Carol Browner, Administrator, US EPA, Civil Action 96-0826 LH/LFG, 1997) list and which are due within the first two years of the monitoring schedule. Once assessment monitoring is completed those reaches showing impacts and requiring a TMDL will be targeted for more intensive monitoring.

The methods of data acquisition include fixed-station monitoring, intensive surveys of priority waterbodies, including biological assessments, and compliance monitoring of industrial, federal and municipal dischargers, and are specified in the SWQB Assessment Protocol (SWQB/NMED 2000c).

Long term monitoring for assessments will be accomplished through the establishment of sampling sites that are representative of the water body and which can be revisited every five years. This gives an unbiased assessment of the waterbody and establishes a long term monitoring record for simple trend analyses. This information will provide time relevant information for use in 305(b) assessments and to support the need for developing TMDLs.

The approach provides:

- A systematic, detailed review of water quality data, allowing for a more efficient use of valuable monitoring resources.
- Information at a scale where implementation of corrective activities is feasible.
- An established order of rotation and predictable sampling in each basin, which allows forehanded coordinated efforts with other programs.
- Program efficiency and improvements in the basis for management decisions.

It should be noted that a basin would not be ignored during its four-year sampling hiatus. The rotating basin program will be supplemented with other data collection efforts.

Data will be analyzed, field studies will be conducted, to further characterize identified problems, and TMDLs will be developed and implement. Both long term and field studies can contribute to the 305(b) report and 303(d) listing processes.

The following schedule is a draft for the sampling seasons through 2002 and will be followed in a consistent manner to support the New Mexico Unified Watershed Assessment (UWA) and the Nonpoint Source Management Program. This sampling regime allows characterization of seasonal variation and through sampling in spring, summer, and fall for each of the watersheds.

- 1998 Jemez Watershed, Upper Chama Watershed (above El Vado), Cimarron Watershed, Santa Fe River, San Francisco Watershed
- 1999 Lower Chama Watershed, Red River Watershed, Middle Rio Grande, Gila River Watershed (summer and fall), Santa Fe River
- 2000 Gila River Watershed (spring), Dry Cimarron Watershed, Upper Rio Grande 1 (Pilar north to the NM/CO border), Shumway Arroyo
- 2001 Upper Rio Grande 2 (Pilar south to Cochiti Reservoir), Upper Pecos Watershed (Ft Sumner north to the headwaters
- 2002 Lower Pecos Watershed (Roswell south to the NM/TX border including Ruidoso), Canadian River Watershed, Lower Rio Grande (southern border of Isleta Pueblo south to the NM/TX border), San Juan River Watershed, Rio Puerco Watershed, Closed Basins, Zuni Watershed, Mimbres Watershed

Implementation Plan

Management Measure

Management measures are "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives" (USEPA, 1993). A combination of best management practices (BMPs) and public education will be used to implement this TMDL.

Introduction

The presence of some aquatic vegetation is normal in streams. Algae and macrophytes provide habitat and food for all stream animals. However, an excessive amount of aquatic vegetation is not beneficial to most stream life. The level of nutrient enrichment is often reflected by the types and amounts of aquatic vegetation in the water. High levels of nutrients (especially nitrogen and phosphorus) may promote an overabundance of algae and floating and rooted macrophytes.

Plant respiration and decomposition of dead vegetation consume dissolved oxygen in the water. Lack of dissolved oxygen creates stress for all aquatic organisms and can cause fish kills.
A landowner may have seen fish gulping for air at the water surface during warm weather, indicating a lack of dissolved oxygen (DO). Increases in primary productivity can increase invertebrates and fish in streams. However, excessive plant growth and decomposition can limit aquatic populations by decreasing dissolved oxygen concentrations. Nocturnal respiration can cause oxygen depletion in waters with high primary productivity and low aeration rates.

Reduced base flow, either naturally occurring (drought) or through anthropogenic actions, will also result in higher temperatures, slower water movement, and therefore, show increased nutrient levels.

The following is a list of examples that can contribute to plant nutrient exceedances:

- Point source nutrient contributions can come from wastewater ineffectively treated.
- Nonpoint sources of nutrients can be related to agricultural activities, such as over-application of fertilizer on fields or animal waste runoff including confined animal operations and grazing activities.
- Storm water runoff in urban areas can include fertilizer from lawns and pet waste.
- Septic tanks, cesspools, or any other mechanism for removal of liquid waste fom human habitation are large contributors to surface water nutrients when ground water is shallow or systems have been improperly installed.
- Recreational areas such as horse trails or heavily used fishing areas, where the riparian vegetation has been removed or reduced, can contribute nutrients if waste materials run off into the stream. By removing riparian areas, the filtering mechanism for the runoff is also removed.

- Removal of water, through diversion, can reduce base stream flow and may possibly contribute high plant nutrient levels when temperatures rise. For example, stagnant pools can form in streams during extremely low flows and have excessive amounts of aquatic vegetation.

Actions to be Taken

For this watershed the primary focus will be on the control of plant nutrients.

During the TMDL process in this watershed, point sources have been reviewed and will be addressed through the permit process. The nonpoint source contributions will need to address nutrient exceedances through BMP implementation.

Various BMPs can be used to address plant nutrient exceedances. Examples include:

1. A filter strip or vegetated buffer. These BMPs are particularly advantageous for runoff from agricultural fields and storm water drains because the vegetation would absorb a percentage of the nutrients. This BMP would also prevent sediment loading and turbidity in the river system by providing a filtering process for the runoff. (USEPA 1993. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.)

2. Detention basins are effective techniques for the control of pollutant discharges from storm water runoff and confined animal operations. The basins would isolate potentially polluted runoff from streams. (Urban Targeting and BMP Selection, 1990, US EPA.)

3. Following source control management. Reduced and efficient application of fertilizer on agricultural fields, lawns, golf courses can effectively prevent nutrient loading in runoff. (New Mexico Farm-A-Syst Farmstead Assessment System, 1992, New Mexico State University, College of Agriculture and Home Economics, Cooperative Extension Service, Plant Sciences Department.)

4. Maintaining a healthy riparian ecosystem. The riparian functions to filter sediments from runoff will take up nutrients through root systems and provides shade to reduce ambient sunlight, which also increases aquatic growth. (Revegetating Southwest Riparian Areas, New Mexico State University, College of Agriculture and Home Economics, Cooperative Extension Service.)

Additional sources of information for BMPs to address conductivity are listed below. Some of these documents are available for viewing at the New Mexico Environment Department, Surface Water Quality Bureau, Watershed Protection Section Library, 1190 St. Francis Drive, Santa Fe, New Mexico.

Agriculture

Internet websites:

http://www.nm.nrcs.usda.gov/

http://www.nhq.nrcs.usda.gov/land/env/wq7.html
http://www.agcom.purdue.edu/AgCom/news/backgrd/9804.Joern.phosphorus.html

http://www.umaine.edu/pswl/Nutrient Management.htm

http://www.ag.ohio-state.edu/~ohioline/aex-fact/0464.html

- Bureau of Land Management, 1990, Cows, Creeks, and Cooperation: Three Colorado Success Stories. Colorado State Office.

- Cotton, Scott E. and Ann C. Cotton, Wyoming CRM: Enhancing our Environment.

- Goodloe, Sid, Watershed Restoration through Integrated Resource Management on Public and Private Rangelands.

- Grazing in New Mexico and the Rio Puerco Valley Bibliography.

- Maas, Richard P., Steven A. Dressing, and others, Best Management Practices for Agricultural Nonpoint Source Control, IV. Pesticides. USDA/EPA joint project Rural Nonpoint Source Control Water Quality Evaluation and Technical Assistance.

- New Mexico State University, 1992, New Mexico Farm-A-Syst Farmstead Assessment System. College of Agriculture and Home Economics, Cooperative Extension Service, Plant Sciences Department.

  Section 6, Improving household Wastewater Management
  Section 7, Improving Livestock Waste Storage
  Section 8, Improving Livestock Yards Management

- USEPA Region 6 and Terrene Institute, 1994, Pollution Control for Horse Stables and Backyard Livestock, (handout).

- USEPA Region 4 and Tennessee Valley Authority, Animal Waste Treatment by Constructed Wetlands, (pamphlet).

- USEPA, Animal Waste Treatment by Constructed Wetlands. Water Management Division, Region 5, (pamphlet).

Urban/Storm Water

- Delaware Department of Natural Resources and Environmental Control, 1997, Conservation Design for Stormwater Management: A Design Approach to Reduce Stormwater Impacts from Land Development and Achieve Multiple Objectives Related to Land Use. Sediment and Stormwater Program & the Environment Management Center, Brandywine Conservancy.

- US EPA, 1990, Urban Targeting and BMP Selection. Region V, Water Division.

- Taylor, Scott , and G. Fred Lee, 2000, Stormwater Runoff Water Quality. Science/Engineering Newsletter, Urban Stormwater Runoff Water Quality Management Issues, Vol. 3, No. 2. May 19.

Miscellaneous

Internet website:

http://water.usgs.gov/nawqa/nutrient.html

- International Erosion Control Association, 1994, Sustaining Environmental Quality: The Erosion Control Challenge, Proceedings of Conference XXV, February

- New Mexico Environment Department, 2000, A Guide to Successful Watershed Health. Surface Water Quality Bureau.

- New Mexico Environment Department, Maintaining your Septic System, (pamphlet).

- Terrene Institute, 1991, Your Guide to Preventing Water Pollution.

- USDA Forest Service Southwestern Region, Soil and Water Conservation Practices Handbook.
  1.)Section 22 – Range Management 22-1 through 22-4.
  2.)Section 23 – Recreation 23-2, 23-3, 23-5, & 23-6.

- USEPA, 1992, Managing Nonpoint Source Pollution. Office of Water, EPA-506/9-90.

- USEPA Region 6 and Terrene Institute, 1994, Landscape Design and Maintenance for Pollution Control, (handout).

- USEPA Region 4, 1992, A Common Sense Guide to Rural Environmental Protection .

- USEPA, 1999, Protocol for Developing Nutrient TMDLs. 1st Edition, EPA841-B-99-007.

  1.) Table 2. Common BMPs employed to control nutrient transport from agricultural and urban nonpoint sources, pg. 2-13
  2.) Nutrient Controls, pg.2-12

- USEPA, 1993, Guidance Specifying Management Measures For Sources of Nonpoint Pollution in Coastal Waters. Office of Water, Coastal Zone Act Reauthorization Amendments of 1990 (Authority of §6217(g)), EPA840-B-92-002.

- USEPA, 1999, Protocol for Developing Nutrient TMDLs. Office of Water, 4503 F, Washington DC 20460, EPA841-B-99-007, November, 1st Edition.

- USEPA Region 4, 1992, A Common Sense Guide to Rural Environmental Protection, 345 Courtland Street, N.E., Atlanta, Georgia, 30365, EPA904-B-92-002, September.

- Unknown, Selecting BMPs and other Pollution Control Measures.

- Unknown, Environmental Management. Best Management Practices

  Construction Sites
  Developed Areas
  Sand and Gravel Pits
  Farms, Golf Courses, and Lawns

- Zeedyk, William D., Managing Roads for Wet Meadow Ecosystem Recovery, USDA-FS, Southwestern Region, Report # FHWA-FLP-96-016

Other BMP Activities in the Watershed

The following are activities in this watershed that have occurred, are occurring, or are in the planning stages to address sources, which are contributing to erosion or other nonpoint source issues impacting Centerfire Creek.

The Gila National Forest has been and continues to be involved in management activities on lands in the upper reaches of the Centerfire Creek watershed. Many of these management activities are undertaken to address issues with sediment, turbidity, and water temperature. Grazing and logging were historic land uses in the watershed. Currently, the area is managed by the Forest Service and private landowners with an emphasis on recreation, wildlife, fisheries and grazing. The Forest Service and private landowners actively manage grazing activities on Centerfire Creek. Elk graze the area heavily. Riparian fencing and elk exclosures are planned by the Forest Service along major tributaries, which is a prerequisite to willow planting.

The upper watershed along this TMDL segment has numerous gullies, spanning several allotments, which will, in the future, or have been checked either by earthen dams or gabion baskets. Installation of a trick tank is projected to ease the elk burden on the stream segment. At the present time, private landowner management varies between holders. Private landowners are encouraged to re-seed and mitigate along riparian areas that have been affected by uncontrolled grazing.

A project, which is partially funded by EPA § 319(h) monies, is currently underway. This is the Spur Ranch project, Phase 1 and 2, which is addressing erosion, streambank destabilization, and riparian enhancement issues. Phase 1, was initiated by a private landowner with ranch property along Centerfire Creek. The Spur Ranch Project is a wetlands/riparian restoration project that began in 1997.

Stage I included the development, design and construction of a soil-cement sediment control structure that, when it has trapped its capacity of sediment, will raise the creek level by 6.5 feet. Stage I was designed to accommodate Stage II, which is vital to the success of the project due to the extent/depth of the existing erosion in the current channel.

Stage II involves raising the Stage I structure by an additional 8 feet. By the end of Stage II, the creek level will be raised 14.5 feet and should approximate an historic level, which had a relatively large floodplain that lessened intensity of flooding. Sloping the banks upstream of the structure will facilitate capillary action to establish forage; seeding the sloped banks and planting trees at the base of the banks will reduce sediment deposits in the creek. Thinning and burning the surrounding area will improve watershed function. After the project is completed, monitoring will continue and actions will be taken as required to maintain the integrity of the project by monitoring the structure, by re-seeding areas where the grass does not germinate, by tree planting in areas where the initial stock does not grow and by periodically burning accumulated natural trash and duff.

The Gila National Forest is also planning prescribed burning and timber stand improvements, namely thinning, in the San Francisco River watershed to reduce fuels and improve watershed conditions and wildlife habitat. These efforts will continue within program priorities and funding levels.

Coordination

In this watershed public awareness and involvement will be crucial to the successful implementation of this plan and improved water quality. Staff from the SWQB will work with stakeholders to provide the guidance in developing the Watershed Restoration Action Strategy (WRAS). The WRAS is a written plan intended to provide a long-range vision for various activities and management of resources in a watershed. It includes opportunities for private landowners and public agencies in reducing and preventing impacts to water quality. This long-range strategy will become instrumental in coordinating and achieving a reduction of metals levels and will be used to prevent water quality impacts in the watershed. SWQB staff will assist with any technical assistance such as selection and application of BMPs needed to meet WRAS goals.

The SWQB will work with stakeholders in this watershed to encourage the implementation of BMPs such as pinyon and juniper thinning in areas that have had excessive encroachment of these trees and which are an obvious source of surface runoff and gully formation. The SWQB will also work with the Gila National Forest to determine impacts from recreational use of the San Francisco River, or possible irrigation diversion enhancements can be put into effect. In addition the SWQB will encourage landowners to implement, if applicable, new grazing management to address riparian and watershed issues.

Lastly, the SWQB will encourage all landowners in the watershed to address road issues such as dirt roads, and low water crossings, that have been constructed (or maintained) without proper drainage controls to prevent sediment from reaching watercourses.

Stakeholders in this process will include SWQB, and other partners of the Watershed Restoration Action Strategy such as the Gila National Forest, Catron County Citizens Group, the Town of Luna, the New Mexico State Highway Department, and private landowners.

Implementation of BMPs within the watershed to reduce pollutant loading from nonpoint sources will be on a voluntary basis. Reductions from point sources will be addressed in revisions to discharge permits. Stakeholder public outreach and involvement in the implementation of this TMDL will be ongoing.

Timeline

Implementation Actions	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Public Outreach and Involvement	X	X	X	X	X
Establish Milestones	X				
Secure Funding	X		X		
Implement Management Measures (BMPs)		X	X		
Monitor BMPs		X	X	X	
Determine BMP Effectiveness				X	X
Re-evaluate Milestones				X	X

Section 319(h) Funding Options

The Watershed Protection Section of the SWQB provides USEPA § 319(h) funding to assist in implementation of BMPs to address water quality problems on reaches listed on the § 303(d) list or which are located within Category I Watersheds as identified under the Unified Watershed Assessment of the Clean Water Action Plan. These monies are available to all private, for profit and nonprofit organizations that are authenticated legal entities, or governmental jurisdictions including: cities, counties, tribal entities, Federal agencies, or agencies of the State. Proposals are submitted by applicants through a Request for Proposal (RFP) process and require a non-federal match of 40% of the total project cost consisting of funds and/or in-kind services. Further information on funding from the Clean Water Act § 319 (h) can be found at the New Mexico Environment Department website: http://www.nmenv.state.nm.us/wpstop.html.

Assurances

New Mexico's Water Quality Act (Act) does authorize the Water Quality Control Commission to "promulgate and publish regulations to prevent or abate water pollution in the state" and to require permits. The Act authorizes a constituent agency to take enforcement action against any person who violates a water quality standard. Several statutory provisions on nuisance law could also be applied to nonpoint source water pollution. The Water Quality Act The Water Quality Act also states in § 74-6-12(a):

> *The Water Quality Act (this article) does not grant to the commission or to any other entity the power to take away or modify the property rights in water, nor is it the intention of the Water Quality Act to take away or modify such rights.*

In addition, the State of New Mexico Surface Water Quality Standards (Section 20.6.4.6 C and 20.6.4.10.C, NMAC) states*:*

> *These water quality standards do not grant to the Commission or any other entity the power to create, take away or modify property rights in water.*

New Mexico policies are in accordance with the federal Clean Water Act § 101(g):

It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this Act. It is the further policy of Congress that nothing in this Act shall be construed to supersede or abrogate rights to quantities of water which have been established by any State.

> *Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources*.

New Mexico's Clean Water Action Plan has been developed in a coordinated manner with the State's 303(d) process. All Category I watersheds identified in New Mexico's Unified Watershed Assessment process are totally coincident with the impaired waters lists for 1996 and 1998 as approved by EPA. The State has given a high priority for funding, assessment, and restoration activities to these watersheds.

The description of legal authorities for regulatory controls/management measures in New Mexico's Water Quality Act does not contain enforceable prohibitions directly applicable to nonpoint sources of pollution. The Act does authorize the Water Quality Control Commission to "promulgate and publish regulations to prevent or abate water pollution in the state" and to require permits. Several statutory provisions on nuisance law could also be applied to nonpoint source water pollution. NMED nonpoint source water quality management utilizes a voluntary approach. The State provides technical support and grant monies for implementation of BMPs and other NPS prevention mechanisms through § 319 of the Clean Water Act. Since portions of this TMDL will be implemented through NPS control mechanisms, the New Mexico Watershed Protection Program will target efforts to this and other watersheds with TMDLs. The Watershed Protection Program coordinates with the Nonpoint Source Taskforce. The Nonpoint Source Taskforce is the New Mexico statewide focus group representing Federal and State agencies, local governments, tribes and pueblos, soil and water conservation districts, environmental organizations, industry, and the public.

This group meets on a quarterly basis to provide input on the § 319 program process, to disseminate information to other stakeholders and the public regarding nonpoint source issues, to identify complementary programs and sources of funding, and to help review and rank § 319 proposals.

In order to obtain reasonable assurances for implementation in watersheds with multiple landowners, including Federal, State and private land, NMED has established Memoranda of Understanding (MOUs) with various Federal agencies, in particular the Forest Service and the Bureau of Land Management. MOUs have also been developed with other State agencies, such as the New Mexico State Highway and Transportation Department. These MOUs provide for coordination and consistency in dealing with nonpoint source issues.

Milestones

Milestones will be used to determine if control actions are being implemented and standards attained. For this TMDL, several milestones will be established which will vary and will be determined by the BMPs implemented. Examples of milestones for plant nutrients include:

- Increased educational efforts to agencies/landowners that manage lands/roads to promote better management of sediment that may reach the stream.
- Maintaining a healthy riparian ecosystem.
- Re-seeding and mitigating along riparian areas that have been affected by uncontrolled grazing.
- Reduction in the amount of aquatic vegetation and nutrient levels in the stream.

Milestones will be coordinated by SWQB staff and will be re-evaluated periodically, depending on which BMPs were implemented. Further implementation of this TMDL will be revised based on this reevaluation. As additional information becomes available during the implementation of the TMDL, the targets, load capacity, and allocations may need to be changed. In the event that new data or information show that changes are warranted, TMDL revisions will be made with assistance of the Centerfire Creek Watershed stakeholders.

The re-examination process will involve: monitoring pollutant loading, tracking implementation and effectiveness of controls, assessing water quality trends in the waterbody, and re-evaluating the TMDL for attainment of water quality standards. Although specific targets and allocations are identified in the TMDL, the ultimate success of the TMDL is not whether these targets and allocations are met, but whether beneficial uses and water quality standards are achieved.

Measures of Success

- Improved bank stability and vegetation stability by increasing root systems thus decreasing sediment inputs into the system and improving canopy densities. Measurement tools include but are not limited to canopy densities and root density estimates.

- Increased interagency cooperation via communications with the land management agencies, soliciting their input into the process.

- Increased public participation via pre-monitoring and post-monitoring meetings.

- Increased interagency agreement in determining BMP application and suitability.

- Appropriateness of milestones will be re-evaluated periodically, depending on the BMPs that were implemented. Further implementation of this TMDL will be revised based on this re-evaluation.

Public Participation

Public participation was solicited in development of this TMDL. See Appendix H for flow chart of the public participation process. The draft TMDL was made available for a 30-day comment period starting **October 9, 2001**. Response to comments is attached as Appendix I of this document. The draft document notice of availability was extensively advertised via newsletters, email distribution lists, web page postings (http://www.nmenv.state.nm.us/public_notice.htm) and press releases to area newspapers.

References Cited

Forest Guardians and Southwest Environmental Center v. Carol Browner, Administrator, US EPA, Civil Action 96-0826 LH/LFG, 1997.

Miller, W. E., J.C. Greene and T. Shiroyama. 1978. The *Slenastrum capricornutum* Pritz Algal Assay Bottle Test. Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency, Corvallis, OR EPA-600/9-78-018.

SWQB/NMED. 2000a. Pollutant Source Documentation Protocol.

SWQB/NMED. 2001b. Quality Assurance Project Plan.

SWQB/NMED. 2000c. State of New Mexico Procedures for Assessing Standards Attainment for 303(d) List and 305(b) Report Assessment Protocol.

USEPA. 1993. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. EPA-840-B-92-002. Washington, D.C.

USGS. 2001. Analysis of the Magnitude and Frequency of the 4-day, 3-Year Annual Low-Flow and Two Regional Regression Models for Ungaged Sites on Unregulated Streams in New Mexico. USGS Water-Resources Investigations Report 01.

Appendices

Appendix A: Conversion Factor Derivation

8.34 Conversion Factor Derivation

Million gallons/day **x** Milligrams/liter **x** 8.34 = pounds/day

10^6~~gallons~~/day **x** 3.7854 liters/~~1 gallon~~ **x** 10^{-3}gram/liter **x** 1 pound/454 ~~grams~~ = pounds/day

10^6 (10^{-3}) (3.7854)/454 = 3785.4/454

= 8.3379
= **8.34**

Appendix B: Sonde Data (as part of the Nutrient Assessment DO and pH Protocol)

DateTime M/D/Y	pH	DateTime M/D/Y	pH	DateTime M/D/Y	pH
03/06/2001 20:00	8.56	03/10/2001 0:00	8.33	03/10/2001 18:30	8.37
03/06/2001 21:00	8.51	03/07/2001 15:00	8.72	03/10/2001 19:30	8.33
03/06/2001 22:00	8.46	03/07/2001 16:00	8.66	03/08/2001 10:00	8.38
03/06/2001 23:00	8.43	03/07/2001 17:00	8.56	03/08/2001 11:00	8.45
03/07/2001 0:00	8.41	03/07/2001 18:00	8.6	03/08/2001 12:00	8.53
03/07/2001 1:00	8.42	03/07/2001 19:00	8.59	03/08/2001 13:00	8.56
03/07/2001 2:00	8.43	03/07/2001 20:00	8.5	03/08/2001 14:00	8.59
03/07/2001 3:00	8.43	03/07/2001 21:00	8.45	03/08/2001 15:00	8.56
03/07/2001 4:00	8.41	03/07/2001 22:00	8.43	03/08/2001 16:00	8.54
03/07/2001 5:00	8.39	03/07/2001 23:00	8.4	03/08/2001 17:00	8.54
03/07/2001 6:00	8.38	03/08/2001 0:00	8.35	03/08/2001 18:00	8.51
03/07/2001 7:00	8.36	03/08/2001 1:00	8.32	03/08/2001 19:00	8.44
03/07/2001 8:00	8.35	03/08/2001 2:00	8.31	03/08/2001 20:00	8.45
03/07/2001 9:00	8.39	03/08/2001 3:00	8.29	03/08/2001 21:00	8.43
03/07/2001 10:00	8.45	03/08/2001 4:00	8.28	03/08/2001 22:00	8.38
03/07/2001 11:00	8.54	03/08/2001 5:00	8.27	03/08/2001 23:00	8.36
03/07/2001 12:00	8.61	03/08/2001 6:00	8.26	03/09/2001 0:00	8.36
03/07/2001 13:00	8.65	03/08/2001 7:00	8.25	03/09/2001 1:00	8.35
03/07/2001 14:00	8.68	03/08/2001 8:00	8.26	03/09/2001 2:00	8.34
03/09/2001 5:00	8.29	03/08/2001 9:00	8.28	03/09/2001 3:00	8.32
03/09/2001 6:00	8.27	03/10/2001 0:30	8.3	03/09/2001 4:00	8.3
03/09/2001 7:00	8.25	03/10/2001 1:30	8.26	03/10/2001 20:00	8.32
03/09/2001 8:00	8.25	03/10/2001 2:30	8.24	03/10/2001 21:00	8.3
03/09/2001 9:00	8.31	03/10/2001 3:30	8.21	03/10/2001 22:00	8.28
03/09/2001 10:00	8.34	03/10/2001 4:30	8.21	03/10/2001 23:00	8.26
03/09/2001 11:00	8.4	03/10/2001 5:30	8.22	03/11/2001 0:00	8.26
03/09/2001 12:00	8.47	03/10/2001 6:30	8.23	03/11/2001 1:00	8.25
03/09/2001 13:00	8.51	03/10/2001 7:30	8.24	03/11/2001 2:00	8.24
03/09/2001 14:00	8.54	03/10/2001 8:30	8.21	03/11/2001 3:00	8.23
03/09/2001 15:00	8.57	03/10/2001 9:30	8.25	03/11/2001 4:00	8.24
03/09/2001 16:00	8.55	03/10/2001 10:30	8.27	03/11/2001 5:00	8.24
03/09/2001 17:00	8.55	03/10/2001 11:30	8.24	03/11/2001 6:00	8.23
03/09/2001 18:00	8.44	03/10/2001 12:30	8.28	03/11/2001 7:00	8.21
03/09/2001 19:00	8.51	03/10/2001 13:30	8.26	03/11/2001 8:00	8.22
03/09/2001 20:00	8.42	03/10/2001 14:30	8.3	03/11/2001 9:00	8.28
03/09/2001 21:00	8.35	03/10/2001 15:30	8.42	03/11/2001 10:00	8.37
03/09/2001 22:00	8.3	03/10/2001 16:30	8.44	03/11/2001 11:00	8.42
03/09/2001 23:00	8.33	03/10/2001 17:30	8.35	03/11/2001 12:00	8.51

DateTime M/D/Y	pH	DateTime M/D/Y	pH
03/11/2001 13:00	8.54	03/13/2001 5:00	8.31
03/11/2001 14:00	8.55	03/13/2001 6:00	8.31
03/11/2001 15:00	8.57	03/13/2001 7:00	8.3
03/11/2001 16:00	8.58	03/13/2001 8:00	8.28
03/11/2001 17:00	8.52	03/13/2001 9:00	8.3
03/11/2001 18:00	8.44	03/13/2001 10:00	8.41
03/11/2001 19:00	8.46	03/13/2001 11:00	8.47
03/11/2001 20:00	8.35	03/13/2001 12:00	8.57
03/11/2001 21:00	8.33	03/13/2001 13:00	8.63
03/11/2001 22:00	8.35	03/13/2001 14:00	8.64
03/11/2001 23:00	8.34	03/13/2001 15:00	8.65
03/12/2001 0:00	8.31	03/13/2001 16:00	8.63
03/12/2001 1:00	8.29	03/13/2001 17:00	8.55
03/12/2001 2:00	8.27	03/13/2001 18:00	8.54
03/12/2001 3:00	8.27	03/13/2001 19:00	8.51
03/12/2001 4:00	8.27	03/13/2001 20:00	8.43
03/12/2001 5:00	8.27	03/13/2001 21:00	8.33
03/12/2001 6:00	8.27	03/13/2001 22:00	8.28
03/12/2001 7:00	8.26	03/13/2001 23:00	8.27
03/12/2001 8:00	8.25	03/14/2001 0:00	8.29
03/12/2001 9:00	8.3	03/14/2001 1:00	8.31
03/12/2001 10:00	8.37	03/14/2001 2:00	8.32
03/12/2001 12:00	8.57	03/14/2001 2:30	8.32
03/12/2001 13:00	8.58	03/14/2001 3:00	8.31
03/12/2001 14:00	8.62	03/14/2001 3:30	8.31
03/12/2001 15:00	8.61	03/14/2001 4:00	8.3
03/12/2001 16:00	8.55	03/14/2001 4:30	8.3
03/12/2001 17:00	8.46	03/14/2001 5:00	8.3
03/12/2001 18:00	8.51	03/14/2001 5:30	8.29
03/12/2001 19:00	8.5	03/14/2001 6:00	8.29
03/12/2001 20:00	8.43	03/14/2001 6:30	8.29
03/12/2001 21:00	8.37	03/14/2001 7:00	8.29
03/12/2001 22:00	8.35	03/14/2001 7:30	8.28
03/12/2001 23:00	8.34	03/14/2001 8:00	8.26
03/13/2001 0:00	8.33	03/14/2001 8:30	8.26
03/13/2001 1:00	8.31	03/14/2001 9:00	8.3
03/13/2001 2:00	8.3	03/14/2001 9:30	8.39
03/13/2001 3:00	8.3	03/14/2001 10:00	8.41
03/13/2001 4:00	8.3		

DateTime M/D/Y	DO Conc mg/L	pH	DateTime M/D/Y	DO Conc mg/L	pH
05/08/2001 6:41	6.23	7.35	05/10/2001 7:00	9.08	8.45
05/08/2001 18:00	8.18	8.88	05/10/2001 8:00	9.42	8.47
05/08/2001 19:00	8.19	8.86	05/10/2001 9:00	9.74	8.5
05/08/2001 20:00	8.07	8.83	05/10/2001 10:00	9.98	8.55
05/08/2001 21:00	8	8.79	05/10/2001 11:00	10.03	8.64
05/08/2001 22:00	7.84	8.73	05/10/2001 12:00	9.92	8.74
05/08/2001 23:00	7.78	8.68	05/10/2001 13:00	9.61	8.84
05/09/2001 0:00	7.77	8.61	05/10/2001 14:00	9.46	8.92
05/09/2001 1:00	7.83	8.56	05/10/2001 15:00	9.05	8.99
05/09/2001 2:00	7.93	8.52	05/10/2001 16:00	8.72	9.03
05/09/2001 3:00	8.1	8.48	05/10/2001 17:00	8.43	9.02
05/09/2001 4:00	8.27	8.46	05/10/2001 18:00	8.39	8.98
05/09/2001 5:00	8.49	8.44	05/10/2001 19:00	8.32	8.94
05/09/2001 6:00	8.72	8.44	05/10/2001 20:00	8.15	8.89
05/09/2001 7:00	9	8.44	05/10/2001 21:00	8.04	8.85
05/09/2001 8:00	9.31	8.45	05/10/2001 22:00	7.96	8.79
05/09/2001 9:00	9.62	8.48	05/10/2001 23:00	7.89	8.73
05/09/2001 10:00	9.86	8.54	05/11/2001 0:00	7.9	8.66
05/09/2001 11:00	9.89	8.61	05/11/2001 1:00	8.06	8.6
05/09/2001 12:00	9.73	8.71	05/11/2001 2:00	8.12	8.55
05/09/2001 13:00	9.31	8.81	05/11/2001 3:00	8.29	8.51
05/09/2001 14:00	8.91	8.85	05/11/2001 4:00	8.53	8.49
05/09/2001 15:00	8.65	8.86	05/11/2001 5:00	8.72	8.47
05/09/2001 16:00	8.46	8.83	05/11/2001 6:00	8.96	8.46
05/09/2001 17:00	8.55	8.83	05/11/2001 7:00	9.26	8.46
05/09/2001 18:00	8.72	8.81	05/11/2001 8:00	9.59	8.47
05/09/2001 19:00	8.79	8.83	05/11/2001 9:00	9.88	8.5
05/09/2001 20:00	8.65	8.83	05/11/2001 10:00	10.05	8.55
05/09/2001 21:00	8.45	8.81	05/11/2001 11:00	10.06	8.64
05/09/2001 22:00	8.23	8.77	05/11/2001 12:00	9.88	8.74
05/09/2001 23:00	8.08	8.72	05/11/2001 13:00	9.5	8.87
05/10/2001 0:00	8.05	8.65	05/11/2001 14:00	8.99	8.98
05/10/2001 1:00	8.07	8.59	05/11/2001 15:00	8.47	9.04
05/10/2001 2:00	8.11	8.54	05/11/2001 16:00	8.23	9.08
05/10/2001 3:00	8.24	8.5	05/11/2001 17:00	8.22	9.06
05/10/2001 4:00	8.43	8.48	05/11/2001 18:00	8.11	9.05
05/10/2001 5:00	8.59	8.46	05/11/2001 19:00	8.07	9.02
05/10/2001 6:00	8.8	8.45	05/11/2001 20:00	7.92	8.97

DateTime M/D/Y	DO Conc mg/L	pH	DateTime M/D/Y	DO Conc mg/L	pH
05/11/2001 21:00	7.86	8.88	05/13/2001 12:00	9.33	8.74
05/11/2001 22:00	7.79	8.79	05/13/2001 13:00	9.15	8.83
05/11/2001 23:00	7.83	8.7	05/13/2001 14:00	8.98	8.89
05/12/2001 0:00	7.89	8.65	05/13/2001 15:00	8.85	8.95
05/12/2001 1:00	7.94	8.62	05/13/2001 16:00	8.46	8.98
05/12/2001 2:00	7.98	8.59	05/13/2001 17:00	8.4	8.99
05/12/2001 3:00	8.06	8.54	05/13/2001 18:00	8.38	8.96
05/12/2001 4:00	8.16	8.51	05/13/2001 19:00	8.17	8.94
05/12/2001 5:00	8.31	8.48	05/13/2001 20:00	8.07	8.91
05/12/2001 6:00	8.38	8.46	05/13/2001 21:00	7.89	8.85
05/12/2001 7:00	8.57	8.46	05/13/2001 22:00	7.75	8.75
05/12/2001 8:00	8.92	8.47	05/13/2001 23:00	7.65	8.64
05/12/2001 9:00	9.19	8.49	05/14/2001 0:00	7.65	8.57
05/12/2001 10:00	9.48	8.52	05/14/2001 1:00	7.7	8.51
05/12/2001 11:00	9.52	8.61	05/14/2001 2:00	7.75	8.47
05/12/2001 12:00	9.31	8.73	05/14/2001 3:00	7.9	8.43
05/12/2001 13:00	9.11	8.82	05/14/2001 4:00	8.01	8.4
05/12/2001 14:00	8.85	8.92	05/14/2001 5:00	8.12	8.38
05/12/2001 15:00	8.6	8.98	05/14/2001 6:00	8.22	8.37
05/12/2001 16:00	8.34	9.01	05/14/2001 7:00	8.38	8.37
05/12/2001 17:00	8.25	8.99	05/14/2001 8:00	8.65	8.4
05/12/2001 18:00	8.26	8.94	05/14/2001 9:00	8.92	8.44
05/12/2001 19:00	8.16	8.9	05/14/2001 10:00	9.15	8.51
05/12/2001 20:00	8.01	8.86	05/14/2001 11:00	9.37	8.63
05/12/2001 21:00	7.84	8.76	05/14/2001 12:00	9.52	8.75
05/12/2001 22:00	7.76	8.68	05/14/2001 13:00	9.62	8.85
05/12/2001 23:00	7.72	8.61	05/14/2001 14:00	9.55	8.92
05/13/2001 0:00	7.81	8.56	05/14/2001 15:00	9.24	8.97
05/13/2001 1:00	7.78	8.53	05/14/2001 16:00	9.17	8.99
05/13/2001 2:00	7.84	8.5	05/14/2001 17:00	9.04	8.99
05/13/2001 3:00	7.94	8.44	05/14/2001 18:00	9.08	9
05/13/2001 4:00	8.02	8.43	05/14/2001 19:00	8.76	9.01
05/13/2001 5:00	8.14	8.42	05/14/2001 20:00	8.6	8.96
05/13/2001 6:00	8.21	8.42	05/14/2001 21:00	8.27	8.88
05/13/2001 7:00	8.37	8.42	05/14/2001 22:00	8.12	8.79
05/13/2001 8:00	8.62	8.43	05/14/2001 23:00	7.95	8.71
05/13/2001 9:00	8.89	8.45	05/15/2001 0:00	7.89	8.62
05/13/2001 10:00	9.25	8.52	05/15/2001 1:00	7.84	8.55
05/13/2001 11:00	9.4	8.64	05/15/2001 2:00	7.87	8.48

DateTime M/D/Y	DO Conc mg/L	pH	DateTime M/D/Y	DO Conc mg/L	pH
05/15/2001 3:00	7.93	8.44	05/16/2001 15:00	8.51	9.03
05/15/2001 4:00	7.99	8.41	05/16/2001 16:00	8.38	9.13
05/15/2001 5:00	8.05	8.39	05/16/2001 17:00	8.24	9.21
05/15/2001 6:00	8.22	8.38	05/16/2001 18:00	8.16	9.21
05/15/2001 7:00	8.49	8.39	05/16/2001 19:00	8.03	9.18
05/15/2001 8:00	8.79	8.41	05/16/2001 20:00	7.77	9.13
05/15/2001 9:00	9.1	8.46	05/16/2001 21:00	7.43	9.03
05/15/2001 10:00	4.62	8.53	05/16/2001 22:00	7.24	8.92
05/15/2001 11:00	9.44	8.64	05/16/2001 23:00	7.18	8.77
05/15/2001 12:00	9.27	8.76	05/17/2001 0:00	7.15	8.64
05/15/2001 13:00	9.08	8.89	05/17/2001 1:00	7.34	8.57
05/15/2001 14:00	8.96	9	05/17/2001 2:00	7.29	8.52
05/15/2001 15:00	8.74	9.1	05/17/2001 3:00	7.68	8.47
05/15/2001 16:00	8.5	9.18	05/17/2001 4:00	7.82	8.43
05/15/2001 17:00	8.35	9.22	05/17/2001 5:00	7.94	8.41
05/15/2001 18:00	8.14	9.22	05/17/2001 6:00	8.04	8.4
05/15/2001 19:00	8.06	9.19	05/17/2001 7:00	8.28	8.39
05/15/2001 20:00	7.85	9.13	05/17/2001 8:00	8.61	8.41
05/15/2001 21:00	7.56	9.02	05/17/2001 9:00	8.9	8.44
05/15/2001 22:00	7.45	8.9	05/17/2001 10:00	9.06	8.48
05/15/2001 23:00	7.44	8.78	05/17/2001 11:00	9.23	8.56
05/16/2001 0:00	7.51	8.7	05/17/2001 12:00	9.09	8.66
05/16/2001 1:00	7.6	8.6	05/17/2001 13:00	8.81	8.77
05/16/2001 2:00	7.7	8.54	05/17/2001 14:00	8.58	8.87
05/16/2001 3:00	7.79	8.49	05/17/2001 15:00	8.49	8.96
05/16/2001 4:00	7.89	8.44	05/17/2001 16:00	8.38	9.03
05/16/2001 5:00	8.01	8.41	05/17/2001 17:00	8.18	9.12
05/16/2001 6:00	8.15	8.4	05/17/2001 18:00	8.26	9.2
05/16/2001 7:00	8.37	8.4	05/17/2001 19:00	8.18	9.24
05/16/2001 8:00	8.74	8.42	05/17/2001 20:00	8.02	9.22
05/16/2001 9:00	8.97	8.44	05/17/2001 21:00	7.73	9.18
05/16/2001 10:00	9.13	8.49	05/17/2001 22:00	7.55	9.09
05/16/2001 11:00	9.15	8.57	05/17/2001 23:00	7.51	8.98
05/16/2001 12:00	9.06	8.7	05/18/2001 0:00	7.49	8.79
05/16/2001 13:00	8.91	8.81	05/18/2001 1:00	7.56	8.71
05/16/2001 14:00	8.64	8.91	05/18/2001 2:00	7.67	8.61

DateTime M/D/Y	DO Conc mg/L	pH	DateTime M/D/Y	DO Conc mg/L	pH
05/18/2001 3:00	7.74	8.54	06/22/2001 8:00	7.13	8.83
05/18/2001 4:00	7.83	8.5	06/22/2001 9:00	7.99	8.9
05/18/2001 5:00	7.92	8.45	06/22/2001 10:00	8.34	8.93
05/18/2001 6:00	8.03	8.42	06/22/2001 11:00	8.49	8.95
05/18/2001 7:00	8.25	8.41	06/22/2001 12:00	9.05	9
05/18/2001 8:00	8.61	8.43	06/22/2001 13:00	9.13	9.04
05/18/2001 9:00	8.87	8.45	06/22/2001 14:00	9.07	9.05
05/18/2001 10:00	7.56	8.53	06/22/2001 15:00	8.57	9.08
05/18/2001 11:00	5.78	8.38	06/22/2001 16:00	7.85	8.96
05/18/2001 12:00	5.53	8.23	06/22/2001 17:00	7.58	9.08
05/18/2001 13:00	5.72	8.11	06/22/2001 18:00	7.88	9.09
05/18/2001 14:00	5.53	8	06/22/2001 19:00	7.8	9.05
05/18/2001 15:00	5.51	7.9	06/22/2001 20:00	7.45	9.01
05/18/2001 16:00	4.9	7.85	06/22/2001 21:00	6.95	8.99
05/18/2001 17:00	4.9	7.76	06/22/2001 22:00	6.61	8.98
05/18/2001 18:00	4.52	7.94	06/22/2001 23:00	6.54	8.92
06/21/2001 9:00	8.11	8.91	06/23/2001 0:00	6.45	8.89
06/21/2001 10:00	8.46	8.93	06/23/2001 1:00	6.41	8.87
06/21/2001 11:00	8.82	8.96	06/23/2001 2:00	6.34	8.86
06/21/2001 12:00	9.31	9.01	06/23/2001 3:00	6.33	8.83
06/21/2001 13:00	9.29	9.03	06/23/2001 4:00	6.26	8.8
06/21/2001 14:00	9.01	9.03	06/23/2001 5:00	6.28	8.76
06/21/2001 15:00	8.52	9.04	06/23/2001 6:00	6.2	8.71
06/21/2001 16:00	8.53	9.1	06/23/2001 7:00	6.4	8.7
06/21/2001 17:00	8.7	9.15	06/23/2001 8:00	7.4	8.8
06/21/2001 18:00	8.66	9.15	06/23/2001 9:00	8.2	8.85
06/21/2001 19:00	8.42	9.11	06/23/2001 10:00	8.56	8.9
06/21/2001 20:00	7.82	9.09	06/23/2001 11:00	8.75	8.92
06/21/2001 21:00	7.08	9.05	06/23/2001 12:00	9.16	8.96
06/21/2001 22:00	6.77	9.05	06/23/2001 13:00	9.4	9.05
06/21/2001 23:00	6.67	9.05	06/23/2001 14:00	9.19	9.08
06/22/2001 0:00	6.51	9	06/23/2001 15:00	9.14	9.15
06/22/2001 1:00	6.41	8.99	06/23/2001 16:00	8.89	9.16
06/22/2001 2:00	6.32	8.96	06/23/2001 17:00	8.66	9.17
06/22/2001 3:00	6.27	8.94	06/23/2001 18:00	8.19	9.01
06/22/2001 4:00	6.2	8.9	06/23/2001 19:00	7.68	8.99
06/22/2001 5:00	6.15	8.84	06/23/2001 20:00	7.17	8.98
06/22/2001 6:00	6.12	8.78	06/23/2001 21:00	6.78	8.98
06/22/2001 7:00	6.26	8.77	06/23/2001 22:00	6.48	8.98

DateTime M/D/Y	DO Conc mg/L	pH	DateTime M/D/Y	DO Conc mg/L	pH
06/23/2001 23:00	6.37	8.99	06/25/2001 13:00	9.4	9.03
06/24/2001 0:00	6.21	8.97	06/25/2001 14:00	8.7	9.1
06/24/2001 1:00	6.13	8.95	06/25/2001 15:00	9.28	9.15
06/24/2001 2:00	6.09	8.91	06/25/2001 16:00	9.55	9.29
06/24/2001 3:00	6.05	8.9	06/25/2001 17:00	9.33	9.29
06/24/2001 4:00	6.05	8.87	06/25/2001 18:00	8.96	9.26
06/24/2001 5:00	6.02	8.84	06/25/2001 19:00	8.69	9.28
06/24/2001 6:00	6.07	8.81	06/25/2001 20:00	7.91	9.22
06/24/2001 7:00	6.28	8.8	06/25/2001 21:00	6.99	9.15
06/24/2001 8:00	7.29	8.88	06/25/2001 22:00	6.55	9.1
06/24/2001 9:00	8.06	8.94	06/25/2001 23:00	6.27	9.1
06/24/2001 10:00	8.45	8.97	06/26/2001 0:00	6.21	9.1
06/24/2001 11:00	8.77	9	06/26/2001 1:00	6.22	9.11
06/24/2001 12:00	9.07	9.03	06/26/2001 2:00	6.16	9.08
06/24/2001 13:00	9.11	9.08	06/26/2001 3:00	6.2	9.02
06/24/2001 14:00	9.07	9.13	06/26/2001 4:00	6.15	9.01
06/24/2001 15:00	9.07	9.16	06/26/2001 5:00	6.19	8.94
06/24/2001 16:00	8.94	9.2	06/26/2001 6:00	6.11	8.91
06/24/2001 17:00	8.57	9.21	06/26/2001 7:00	6.42	8.91
06/24/2001 18:00	8.37	9.22	06/26/2001 8:00	6.9	8.94
06/24/2001 19:00	8.14	9.25	06/26/2001 9:00	7.74	9
06/24/2001 20:00	7.63	9.24	06/26/2001 10:00	7.82	8.99
06/24/2001 21:00	7.24	9.22	06/26/2001 11:00	8.69	8.92
06/24/2001 22:00	6.42	9.21	06/26/2001 12:00	8.48	8.88
06/24/2001 23:00	6.28	9.17	06/26/2001 13:00	8.52	8.88
06/25/2001 0:00	6.21	9.14	06/26/2001 14:00	8.49	8.93
06/25/2001 1:00	6.1	9.11	06/26/2001 15:00	8.44	8.98
06/25/2001 2:00	6.05	9.07	06/26/2001 16:00	8.32	9.02
06/25/2001 3:00	5.96	9.04	06/26/2001 17:00	8.2	9.04
06/25/2001 4:00	5.96	8.99	06/26/2001 18:00	8.26	9.07
06/25/2001 5:00	5.96	8.93	06/26/2001 19:00	7.88	9.06
06/25/2001 6:00	5.91	8.93	06/26/2001 20:00	7.68	9.07
06/25/2001 7:00	6.07	8.89	06/26/2001 21:00	7.26	9.02
06/25/2001 8:00	6.92	8.97	06/26/2001 22:00	7.1	8.98
06/25/2001 9:00	7.5	9	06/26/2001 23:00	6.82	8.95
06/25/2001 10:00	8.19	9.03	06/27/2001 0:00	6.55	8.89
06/25/2001 11:00	8.65	9.09	06/27/2001 1:00	6.41	8.84
06/25/2001 12:00	8.91	9.09	06/27/2001 2:00	6.28	8.78

DateTime M/D/Y	DO Conc mg/L	pH
06/27/2001 3:00	6.07	8.72
06/27/2001 4:00	6.02	8.67
06/27/2001 5:00	5.93	8.62
06/27/2001 6:00	5.91	8.58
06/27/2001 7:00	6.18	8.58
06/27/2001 8:00	6.99	8.65
06/27/2001 9:00	7.56	8.71
06/27/2001 10:00	8.09	8.77
06/27/2001 11:00	8.8	8.85
06/27/2001 12:00	9.35	8.98
06/27/2001 13:00	8.92	8.99
06/27/2001 14:00	8.82	9.06
06/27/2001 15:00	8.75	9.09
06/27/2001 16:00	8.55	9.11
06/27/2001 17:00	8.25	9.24
06/27/2001 18:00	7.73	9.13
06/27/2001 19:00	7.06	9.17
06/27/2001 20:00	6.96	9.2
06/27/2001 21:00	6.53	9.19
06/27/2001 22:00	6.23	9.12
06/27/2001 23:00	5.99	9.13
06/28/2001 0:00	5.81	9.04
06/28/2001 1:00	5.82	8.98
06/28/2001 2:00	5.8	8.93
06/28/2001 3:00	5.74	8.89
06/28/2001 4:00	5.75	8.82
06/28/2001 5:00	5.73	8.75
06/28/2001 6:00	5.72	8.67
06/28/2001 7:00	5.97	8.65
06/28/2001 8:00	7.17	8.76
06/28/2001 9:00	8.14	8.88

Appendix C: 4Q3 Derivation

The regression model developed for the 52 gaging stations in physiographic regions in New Mexico is as follows:

$$4Q3 = 1.409 \times 10^{-4} DA^{0.43} P_w^{3.11}$$

Where;

4Q3 = 4-day, 3-year, low-flow frequency, in cubic feet per second;

DA = drainage area, in square miles; and

P_w = average basin mean winter precipitation 1961-1990, in inches

Centerfire Creek:

$P_w = 9.46$

DA = 137

Slope = 0.164

Elevation = 7592

$$1.27 \text{ cfs} = 1.409 \times 10^{-4}(137)^{0.43}(9.46)^{3.11}$$

Appendix D: 2001 Nutrient Data for Centerfire Creek

2001 Nutrient Data for Centerfire Creek

Analyte	Result	Units	Date
Nitrate and Nitrite	<0.1	mG/L	06/20/2001
	<0.1	mG/L	06/21/2001
Ammonia	<0.1	mG/L	06/28/2001
		mG/L	06/21/2001
TKN	0.227	mG/L	06/20/2001
	0.391	mG/L	06/28/2001
	0.166	mG/L	06/21/2001
Total Phosphorus	<0.03	mG/L	06/20/2001
	<0.03	mG/L	06/21/2001
	0.035	mG/L	06/28/2001

Appendix E: Limiting Nutrient and Algal Bioassay (Abbreviated version)

Algal Growth Potential (AGP) Assays

on

Water from the Gila Area

to

State Of New Mexico
Environment Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, New Mexico 87502

submitted to

Julie Tsatsaros

July 30, 2001

by

Larry L. Barton and Gordon V. Johnson

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Background:

The water was collected on 06-18/19/20/21-01 and transported on ice to our laboratory. The initial tests for growth potential were initiated two days later and were terminated after 14 days of incubation. Water from each site was autoclaved and filtered, and stored at 4^{o} C for one week before the 14 day study concerning additions of nitrogen and phosphorus was initiated.

The procedures used for determining limiting nutrients and toxicity to algae was as established in the EPA-600/9-78-018 publication entitled The *Selenastrum Capricornutum* Prinz Algal Assay Bottle Test@ and EPA-660/3-75-034 publication entitled Proceedings: Biostimulation/and/ Nutrient Assessment Workshop@ The design is as follows:

Water from the creeks/rivers was autoclaved and passed through filters which had a pore diameter of 0.4 micrometers. The filtered water, 25 ml, was placed in 125 ml Erlenmeyer flasks which were covered with aluminum foil. Each assay was conducted in triplicate under laboratory conditions with continual fluorescent lighting..

The design of the test for algal growth potential is as listed below:
1. Control (filtered river water with no additions)
2. Control + 0.05 mg P/liter
3. Control + 1.00 mg N/liter
4. Control + 1.00 mg N + 0.05 mg P /liter
5. Control + 1.00 mg Na_2 EDTA/liter
6. Control + 1.00 mg Na_2 EDTA + 0.05 mg P/liter
7. Control + 1.00 mg Na_2 EDTA + 1.00 mg N/liter
8. Control + 1.00 mg Na_2 EDTA + 1.00 mg N + 0.05 mg P/liter
9. Control + 1.00 mg Na_2 EDTA + 1.00 mg N + 0.05 mg P + 4.5 g Fe/liter

At the end of 10 days of incubation, the amount of chlorophyll was determined using fluorescence measurements. The fluorescence values were converted to dry weight values using a standard that we had constructed. The results are given in dry weight measurements as is in accordance with the EPA procedure.

The water samples were designated as follows:

Designation	Site of collection
I	San Francisco River above Luna
II	Center Fire Creek at Spur Ranch
III	Lower Mangus Creek
IV	Canyon Creek

The following statements can be made concerning the individual waters:

San Francisco River above Luna

1. The river water is limiting in nitrogen. When nitrogen is added (see Figure 1) the growth response is linear up to 2.5 mg/L.
2. There is adequate phosphorus in the water to support algal growth even when the amount of nitrogen supplemented is 2.5 mgN/L.
3. As evidenced by the lack of stimulation with the presence of EDTA, there was no toxicity due to heavy metals.

Center Fire Creek at Spur Ranch

The water is slightly limiting in nitrogen. That is, when 0.25 N/L is added, the growth is stimulated; however, further additions of nitrogen do not stimulate algal growth. This indicates that something other than nitrogen becomes limiting. Slight limitation of phosphorus is noted (see Figure 5). Additions of 0.01 and 0.025 mg phosphorus/L stimulates growth; however, further additions do not increase growth. As evidenced by the lack of stimulation with the presence of EDTA, there was no toxicity due to heavy metals.

Lower Mangus Creek

1. The water is not low in available nitrogen because with the addition of nitrogen, there is no increase in algal growth. See Figure 3.
2. The water is definitely low in phosphorus because with the addition of phosphorus (Figure 6) there is nearly linear increase in algal growth.

   As evidenced by the lack of stimulation with the presence of EDTA, there was no toxicity due to heavy metals.

   Without added nutrients, water from Mangus Creek supported nearly four times the algal biomass as did water from San Francisco and Centerfire sites (152.7 mg dry weight of algae/L).

Canyon Creek

1. The water is nitrogen limited in that the addition of nitrogen stimulates algal growth. See Figure 4. Additions of nitrogen up to 1 mg/L give a linear increase in the amount of growth; however, growth above 1 mgN/L is stimulated at a lower level.
2. There is no indication that the water is limiting in phosphorus.
3. As evidenced by the lack of stimulation with the presence of EDTA, there was no toxicity due to heavy metals.
4. Without added nutrients, water from Canyon Creek supported twice the algal biomass as did water from the San Francisco and Center Fire sites.

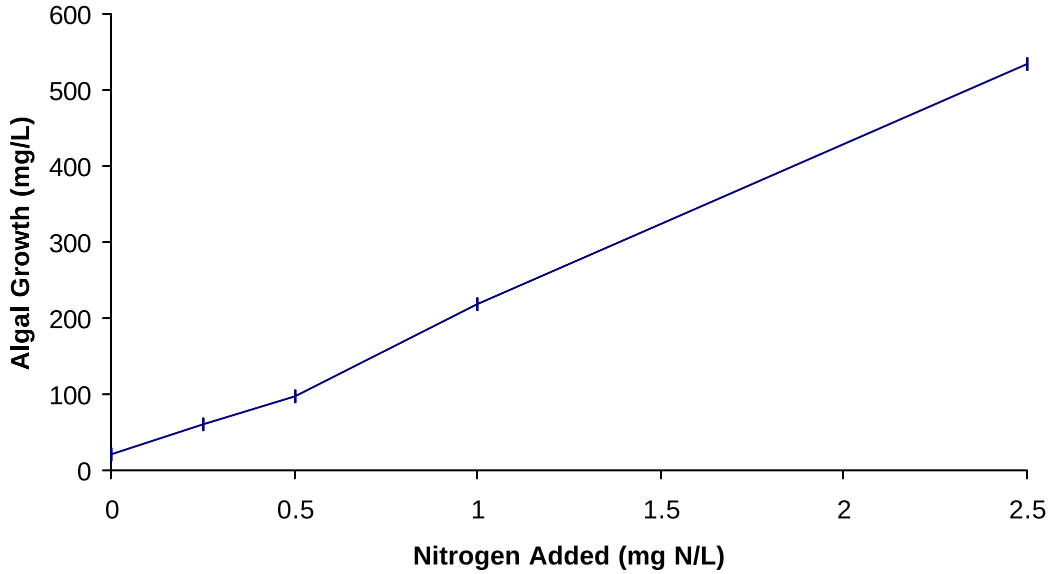


Figure 1 – San Francisco River above Luna

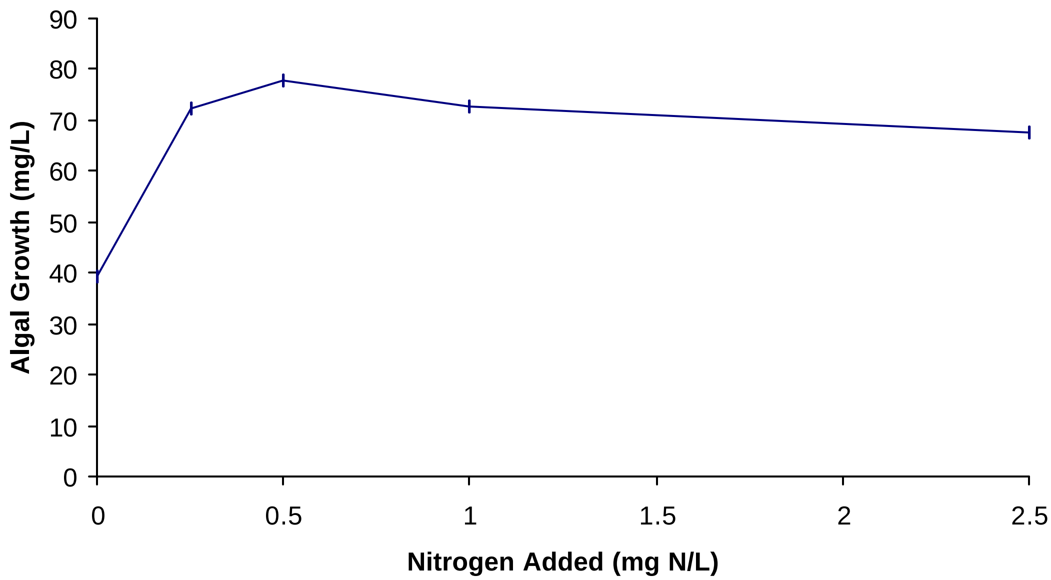


Figure 2 – Center Fire Creek at Spur Ranch

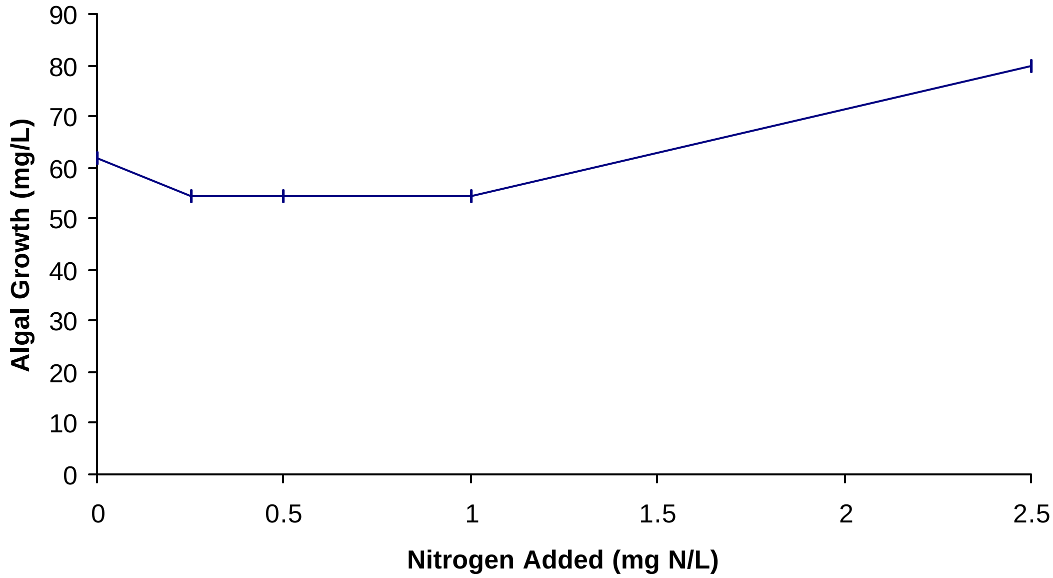


Figure 3 – Lower Mangus Creek

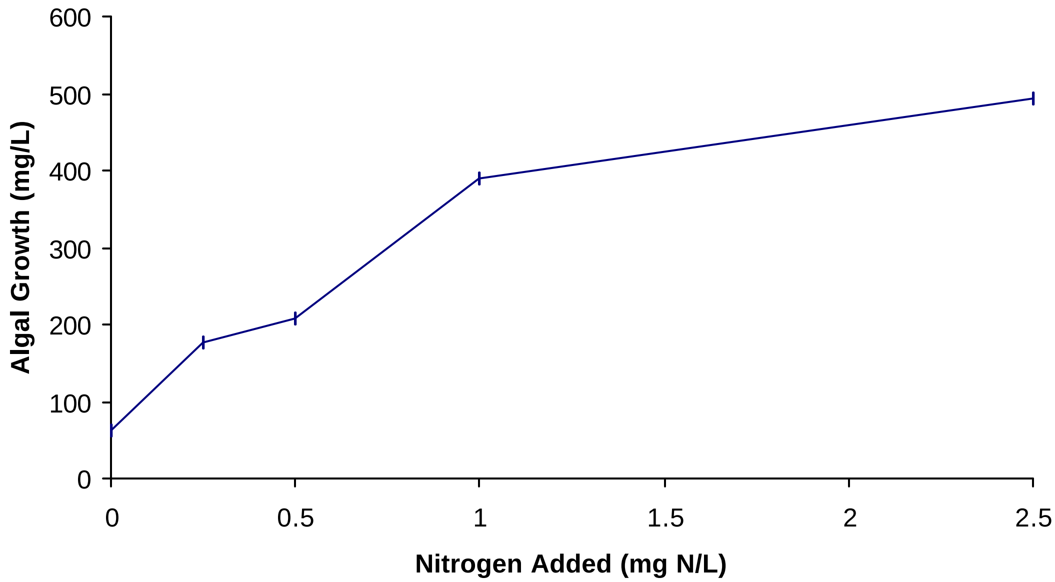


Figure 4 – Canyon Creek

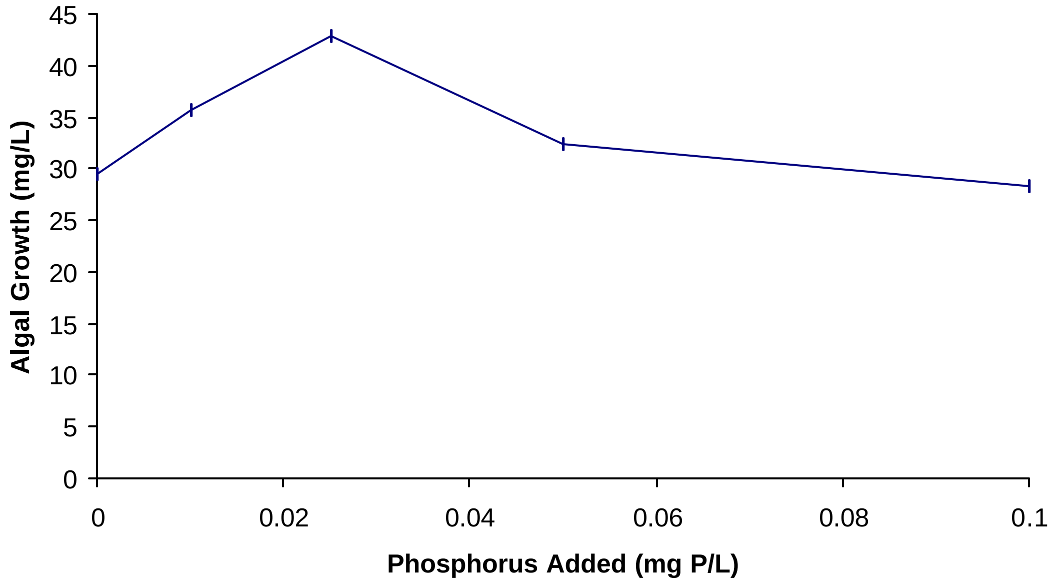


Figure 5 – Center Fire Creek at Spur Ranch

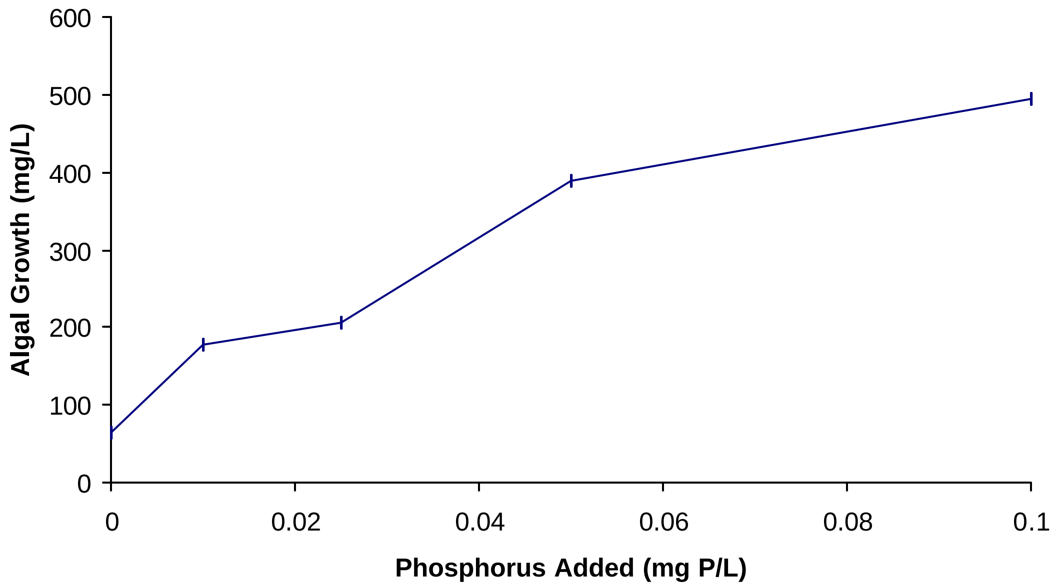


Figure 6 – Lower Mangus Creek

Appendix F: Nutrient Assessment Protocol

NUTRIENT ASSESSMENT PROTOCOL FOR STREAMS

New Mexico Environment Department
Surface Water Quality Bureau

July 2000

Nutrient Assessment Protocol For Streams

Purpose

The purpose of this document is to establish an assessment protocol for the determination of nutrient enrichment of streams. There is no numeric standard for nutrients in New Mexico. The narrative standard reads, "plant nutrients from other than natural causes shall not be present in concentrations which will produce undesirable aquatic life or result in a dominance of nuisance species in surface waters of the state (NMWQCC 2000)". This protocol will be used to assess the need for a TMDL on a reach that is listed on the State of New Mexico's 303 (d) list as impaired by plant nutrients.

Background

The presence of some aquatic vegetation is normal in streams. Algae and macrophytes provide habitat and food for all stream animals. However, an excessive amount of aquatic vegetation is not beneficial to most stream life. The level of nutrient enrichment is often reflected by the types and amounts of aquatic vegetation in the water. High levels of nutrients (especially nitrogen and phosphorus) may promote an overabundance of algae and floating and rooted macrophytes.

Plant respiration and decomposition of dead vegetation consume dissolved oxygen in the water. Lack of dissolved oxygen creates stress for all aquatic organisms and can cause fish kills. A landowner may have seen fish gulping for air at the water surface during warm weather, indicating a lack of dissolved oxygen (DO). Increases in primary productivity can increase invertebrates and fish in streams. However, excessive plant growth and decomposition can limit aquatic populations by decreasing dissolved oxygen concentrations. Nocturnal respiration can cause oxygen depletion in waters with high primary productivity and low reaeration rates. Even relatively small reductions in dissolved oxygen can have adverse effects on both invertebrate and fish communities (EPA 1991). Saturation levels of greater than 115% have been shown to be harmful to aquatic life (Behar 1996). Development of anaerobic conditions will alter a wide range of chemical equilibria, and may mobilize certain pollutants and generate noxious odors (EPA 1991).

Assessment Procedure

The primary question to be answered is: Is this reach nutrient impaired, and is the area of impairment large enough to cause undesirable water quality changes?. A nutrient impaired reach occurs where algal and macrophyte growths interfere with beneficial uses such as primary contact recreation, and high quality coldwater fishery etc. Algal biomass is the most important indicator of nutrient enrichment. Algae are either the direct (excessive, unsightly periphyton mats or surface plankton scums) or indirect (high/low DO and pH and high turbidity) cause of most problems related to excessive nutrient enrichment.

Algal and macrophyte growths may be determined to be a nuisance when there is 1) rotting algae and macrophytes in the stream, 2) substrate in the stream are choked with algae, 3) there are diurnal fluctuations in DO and pH, and/or 4) a release of sediment bound toxins. The EPA criteria for levels of periphyton biomass that are a nuisance are 150 mg^2/m^2 chlorophyll ***a***.

This protocol should be applied in the field during critical seasons, especially during low flow periods such as summer and early fall. Normally, during this time there is more potential to have higher concentrations of plant nutrients in the stream, higher water and air temperatures, decreased periods of scouring, and maximum solar gain. This protocol consists of three levels, which range from a visual to analytical assessments. The different levels of assessment are used in sequential order to determine occurrence of nutrient over enrichment. Level I focuses on visual observations of a system and will usually provide enough information to determine whether a reach is impaired by plant nutrients, although it is often useful to continue with a Level II analysis. A Level II assessment combines analysis of chemical and biological samples to characterize the benthic community and water chemistry. If these measures contain exceedances of surface water quality standards, indicators of excessive primary production (i.e. large D.O. and pH fluctuation and/or high chlorophyll a concentration) or there is an unhealthy benthic community a Level III analysis can be performed. Level III analysis involves more quantitative measures and focuses on the algal and macrophyte community dynamics.

If it is determined that a stream reach is nutrient enriched, a TMDL will be written for that reach. Nutrient enrichment can be determined following a Level I analysis. In most cases, a level II-III analysis will be used to confirm this conclusion.

Level I: Observational with Limited Measures

The following measurement and observations should be made to assess for nutrient enrichment. If any of the measures are apparent, then there would be a strong indication of nutrient enrichment, and the analysis would move to a level II. If a reach is considered "borderline" a more intensive level II-III assessment would be made to further verify.

Location: **Centerfire @ Spur Ranch 06/21/01**

- Determine the presence of excess growth of algae and/or macrophytes. Record a visual estimate of percent algae coverage. Look for lush and deep green thick mats of algae, and dense stands of macrophytes. Coverages of greater than 70% may indicate excessive nutrient enrichment. Also note the presence of algae and macrophytes in the stream, substrate that is choked with algae and/or macrophytes, and where in the stream the growth is occurring (i.e. only on low flow areas, on fine substrate, or large stable substrate etc).

All filamentous algae below the project area-extensive filamentous algae—80-90%. Some macrophytes in the project area. A lot of macrophytes above the sedimentation retention structure.

- Measure dissolved oxygen (D.O); field measurement should be measured in the late afternoon. Determine if the D.O. concentration is above 110% saturation. Only algal production will cause supersaturated DO and high pH during the day. If a D.O. measurement can be taken at night, determine if the concentration exceeds surface water quality standards for that reach. Nocturnal respiration can cause oxygen depletion in waters with high primary productivity and low reaeration rates.

DO was 7.6 mg/L @ 8:30am when sonde was deployed on 6/21/01. Also see sonde data from March and May 2001 (see Appendix B).

- Measure the pH during the late afternoon. High pH is indicative of eutrophic conditions. Determine if the pH exceeds 9 or the standard for the stream reach.

8.88 ntu @ 8:30 am when sonde was deployed on 6/21/01. Also see sonde data from March and May 2001 (see Appendix B).

- Evaluate the coarse substrata (cobbles, boulders, and sand). Note the dominance and subdominant size classes. Look for the presence of slime on the coarse substrate. Note the occurrence and character of the slime (i.e. which substrate it occurs on, its thickness and color etc.). This slime is periphyton and may develop in response to nutrient enrichment.

Gravels---a lot of filamentous algae—a lot of balloon algae—mostly fines above the project area---see pebble count data from the conductivity TMDL for Centerfire Creek

- Identify possible known sources of plant nutrients (i.e., septic, point source, confined animal feeding operations, residential development, fertilizers on agricultural land etc.) utilizing SWQB/NMED 1996b, observations of land use and other sources.

A lot of grazing, elk, low flows, large sixteen foot cut banks which may be contributing a lot of sediment---nutrients may be bound to sediment

- Gather existing data. Compile data on water quality, aquatic communities, land use, etc. for the reach of concern and associated watershed. Determine if the existing data (chemical, biological, land use, etc.) substantiates observational findings?

Grazing

- Observe the color and clarity of the water. Measure the turbidity. Green colored water can indicate the presence of phytoplankton and high levels of total suspended solids (TSS) and turbidity. TSS attenuates light and decreases transparency. High levels of light and TSS and turbidity affect the response of algae to nutrients due to light attenuation and scouring.

TSS in the range of 10-32 mg/L and turbidity in the range of 7-23 NTU may reduce abundance and diversity of benthic macrophytes to graze on the algae (EPA Guidance 1998).

< 10 ntu (also Appendix B)

- Note if black fly larvae or other diptera dominate benthic community

No not a lot of diptera, but quite a few midges are present but not dominant by observation

- Estimate the extent of the impacted area (i.e. the distance of the stream that is impaired.

All perennial portions

- Note where the indicators of nutrient enrichment change.

- Determine if the stream discharges to an impoundment

No

- Note the dominant velocity of the flow. The flow velocity influences algal growth. High flow events can scour the stream channel and reduce algal biomass. Reduced flows may produce drought conditions leading to low levels of algal biomass. Stable, moderate flows that provide plant nutrients may increase eutrophication problems.

< 1 cfs

- Observe the riparian corridor. Record the character of the riparian area noting the height, density and removal of streamside vegetation (rivers need adequate light to develop and maintain high levels of algal biomass), so, an assessment of streamside vegetation will be necessary to determine if there is sufficient light to support an algal bloom.

No riparian corridor.

Level II: Limited Quantitative Measures Taken

Before selecting locations for sampling, walk a couple of hundred meters of the stream to ensure the sampling stations are representative (i.e. are not atypical) of the reach being characterized. The following data should be collected from each site:

- Three to fourteen days of continuous sonde data of dissolved oxygen, pH, conductivity, temperature, and turbidity. Observe predawn measurements for diurnal minimum dissolved oxygen concentrations and afternoon hours for maximum pH. Aquatic organisms are affected most by maximum pH and minimum DO rather than by daily means for those variables.

See March, May and June 2001 sonde data (Appendix B)

- Water samples should be collected for analysis of nutrient concentrations including total phosphorus and nitrogen. Soluble reactive phosphorus and dissolved inorganic nitrogen are the forms available for algal uptake, and are the forms determined (after digestion) for total nitrogen and total phosphorus (EPA Guidance 1998).

See Appendix D

- Algal metabolic rate at a given biomass and growth phase is controlled by temperature, in addition to water movement, nutrients, and light. Nutrient sampling should be conducted monthly to bimonthly during the season of greatest nutrient loading and during the season of greatest algal growth. Some nutrient sampling should also occur during the season of lowest algal biomass levels.

See Appendix D

- Chlorophyll a concentration should be measured by collecting a sample from a known area of substrate or from an artificial substrate (i.e. slides). Chlorophyll *a* concentration is used as a surrogate for algal biomass. **An algal indicator such as chlorophyll *a* is generally the most appropriate monitoring technique (**EPA 1991). Chlorophyll *a* values < 50 mg/m^2 are typical of unenriched or light scoured streams (EPA Guidance 1998). EPA (1998) guidance states that British Columbia developed algal biomass criteria for small wadeable streams: 50 mg/L of chlorophyll a to protect aesthetics, and 100 mg/L to protect against undesirable changes in stream communities.

See Appendix E

- Chlorophyll a is specific to algae, while Ash Free Dry Mass (AFDM) and turbidity includes living and non-living organic matter. **AFDM/Chlorophyll a is an autotrophic index for periphyton productivity, which can distinguish the relative response to inorganic nitrogen, phosphorus and biological oxygen demand (BOD) enrichment.** Streams enriched with inorganic nutrients that have eutrophication problems have ratios of AFDM/chlorophyll a >250, values > 400 indicate organically polluted conditions (EPA 1998).

See Appendix E

- Samples of benthic macroinvertebrates should be collected from the reach being characterized and a suitable reference site. In areas where other stressors such as sediment are not shown to be causing an impairment to the biological community, an assessment using metrics specific to organic enrichment such as the Hilsenhoff Biotic Index, or others as appropriate, should be conducted. **Indices employing macroinvertebrates as indicators of nutrient pollution have great potential. They are the most reliable and frequently used organisms to assess water quality (EPA 1998).** Macroinvertebrates are highly sensitive to changes in water quality and disturbance and are relatively immobile. They are also long lived and easy to sample, and are an important food supply for fish. Karr developed a 10 metric B-IBI index for macroinvertebrates to evaluate the effects of nutrient enrichment.

Macroinvertebrates taken at this site previously

- The ideal sampling procedure to survey the biological community would be to **sample each change of season, and then select appropriate sampling periods that accommodate seasonal variation (EPA 1996).** This ensures sources of ecological disturbance will be monitored and trends documented, and additional information will be available in the event of spills etc. Therefore, the response of the biological community to eposodic events can be assessed (EPA 1996).

Level III: Extensive Quantitative Measures Taken (Diatoms, Phytoplankton, IBA)

Level III analysis uses information gathered in Level I and II assessments combined with additional information that provides a more quantitative measure of over enrichment. In streams benthic algae production and biomass are the most useful of all aquatic flora parameters in monitoring changes in water quality (EPA 1991). Periphyton algal biomass above nuisance levels often produces wide diurnal swings in water quality variables. The use of models such as CE-QUAL-RIV1, QUAL2E, and FORTRAN can be very useful to assess aspects of nutrient overenrichment. CE-QUAL-RIV1 simulates water quality conditions with the highly unsteady flows that can occur in regulated rivers. QUAL2E allows simulation of diurnal variations in temperature or algal photosynthesis and enrichment. FORTRAN simulates water quality and quantity for a wide range of organic and inorganic pollutants from agricultural watersheds (EPA Guidance 1998). The qualitative measures to be taken for Level III Assessment include:

- Identify a reference reach for the test reach and compare the characteristics of the sites including algal biomass, algal community composition, benthic community composition and associated environmental conditions (such as nutrient concentrations, light, canopy cover, substrate, DO and pH).

In streams, benthic algae production and biomass are the most useful of all aquatic flora parameters to monitor changes in water quality (EPA 1991). Periphyton algal biomass above nuisance levels often produces wide diurnal swings in water quality variables due to metabolism.

- River algal growth is likely related to nutrient levels during the season of greatest algal growth. **Generally, sampling once a month from June to September is adequate to assess algal biomass**. Although, if the algal biomass is high enough to cause excessive DO/pH fluctuations that violate water quality standards, then the time frames for those water quality violations should be judged for the accessibility of algal biomass levels (EPA 1996).

- **For benthic algae, biomass, species richness, diversity, and productivity can be measured from natural or artificial substrates.** To reduce variability, algae should be sampled in the part of the stream where algae is most likely to conflict with beneficial uses. A sample of algae should be collected from a known area of natural or artificial substrates and filtered onto glass filter fibers for analysis of chlorophyll a concentration and biomass determination. A sample should also be preserved with formalin for identification. **An autotrophic index can be obtained by measuring the accumulation of organic material (i.e. Biomass) on artificial substrates over a period of one to two weeks.** Until more is known about the natural variability of these parameters, the Chlorophyll a concentration, biomass, and algal composition should be compared to the reference site(s) as well as EPA guidance.

* Benthic macroinvertebrate samples should also be collected from the test reach and a reference site. The benthic community can be assessed using the 1999 RBP. This index of biological integrity (B-IBI) for macroinvertebrates uses a number of metrics that are non-specific to waste type and can evaluate effects of nutrient enrichment (e.g. Number of taxa, percent EPT-mayflies, stoneflies, and caddisflies, percent predators etc.). The advantages of the B-IBI include: low variability and high sensitivity, and absolute background values for a no effect condition (EPA Guidance 1998).

References:

Barbour, M.T., J. Gerritsen, B.D. Snyder and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. USEPA: Office of Water: Washington, D.C.

NMWQCC. 2000. State of New Mexico Standards for Interstate and Intrastate Streams. Santa Fe, NM.

SWQB/NMED. 1996b. Draft Pollutant Source Documentation Protocol.

USDA. 1998. Stream Visual Assessment Protocol, National Water and Climate Center Technical Note 99-1. Washington, DC. 36pp.

USEPA. 1991. Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska. EPA-910-9-91-001. Seattle, WA.

USEPA. 1996. Biological Criteria. Technical Guidance for Streams Rivers Revised Edition. EPA 822-B-96-001.

USEPA. 2000. National Nutrient Assessment Strategy: An Overview of Available Endpoints and Assessment Tools. 2000. HTML#02. USEPA: Office of Water: Washington, D.C.

USEPA. 1998. Technical Guidance Document.

Appendix G: Pollutant Source(s) Documentation Protocol

POLLUTANT SOURCE(S) DOCUMENTATION PROTOCOL

New Mexico Environment Department
Surface Water Quality Bureau
July 1999

This protocol was designed to support federal regulations and guidance requiring states to document and include probable source(s) of pollutant(s) in their §303(d) Lists as well as the States §305(b) Report to Congress.

The following procedure should be used when sampling crews are in the field conducting water quality surveys or at any other time field staff are collecting data.

Pollutant Source Documentation Steps:

1). Obtain a copy of the most current §303(d) List.

2). Obtain copies of the **Field Sheet for Assessing Designated Uses and Nonpoint Sources of Pollution**.

3). Obtain digital camera that has time/date photo stamp on it from the Watershed Protection Section.

4). Obtain GPS unit and instructions from Neal Schaeffer.

5). Identify the reach(s) and probable source(s) of pollutant in the §303(d) List associated with the project that you will be working on.

6). Verify if current source(s) listed in the §303(d) List are accurate.

7). Check the appropriate box(s) on the field sheet for source(s) of nonsupport and estimate percent contribution of each source.

8). Photodocument probable source(s) of pollutant.

9). GPS the probable source site.

10). Give digital camera to Gary King for him to download and create a working photo file of the sites that were documented.

11). Give GPS unit to Neal Schaeffer for downloading and correction factors.

12). Enter the data off of the **Field Sheet for Assessing Designated Uses and Nonpoint Sources of Pollution** into the database.

13). Create a folder for the administrative files, insert field sheet and photodocumentation into the file.

This information will be used to update §303(d) Lists and the States §305(b) Report to Congress.

FIELD SHEET FOR ASSESSING DESIGNATED USES AND NONPOINT SOURCES OF POLLUTION

CODES FOR USES NOT FULLY SUPPORTED

☐	HQCWF =	HIGH QUALITY COLDWATER FISHERY	☐	DWS =	DOMESTIC WATER SUPPLY
☐	CWF =	COLDWATER FISHERY	☐	PC =	PRIMARY CONTACT
☐	MCWF =	MARGINAL COLDWATER FISHERY	☐	IRR =	IRRIGATION
☐	WWF =	WARMWATER FISHERY	☐	LW =	LIVESTOCK WATERING
☐	LWWF =	LIMITED WARMWATER FISHERY	☐	WH =	WILDLIFE HABITAT

Fish culture, secondary contact and municipal and industrial water supply and storage are also designated in particular stream reaches where these uses are actually being realized. However, no numeric standards apply uniquely to these uses.

REACH NAME:

SEGMENT NUMBER:

BASIN:

PARAMETER:

STAFF MAKING ASSESSMENT:

DATE:

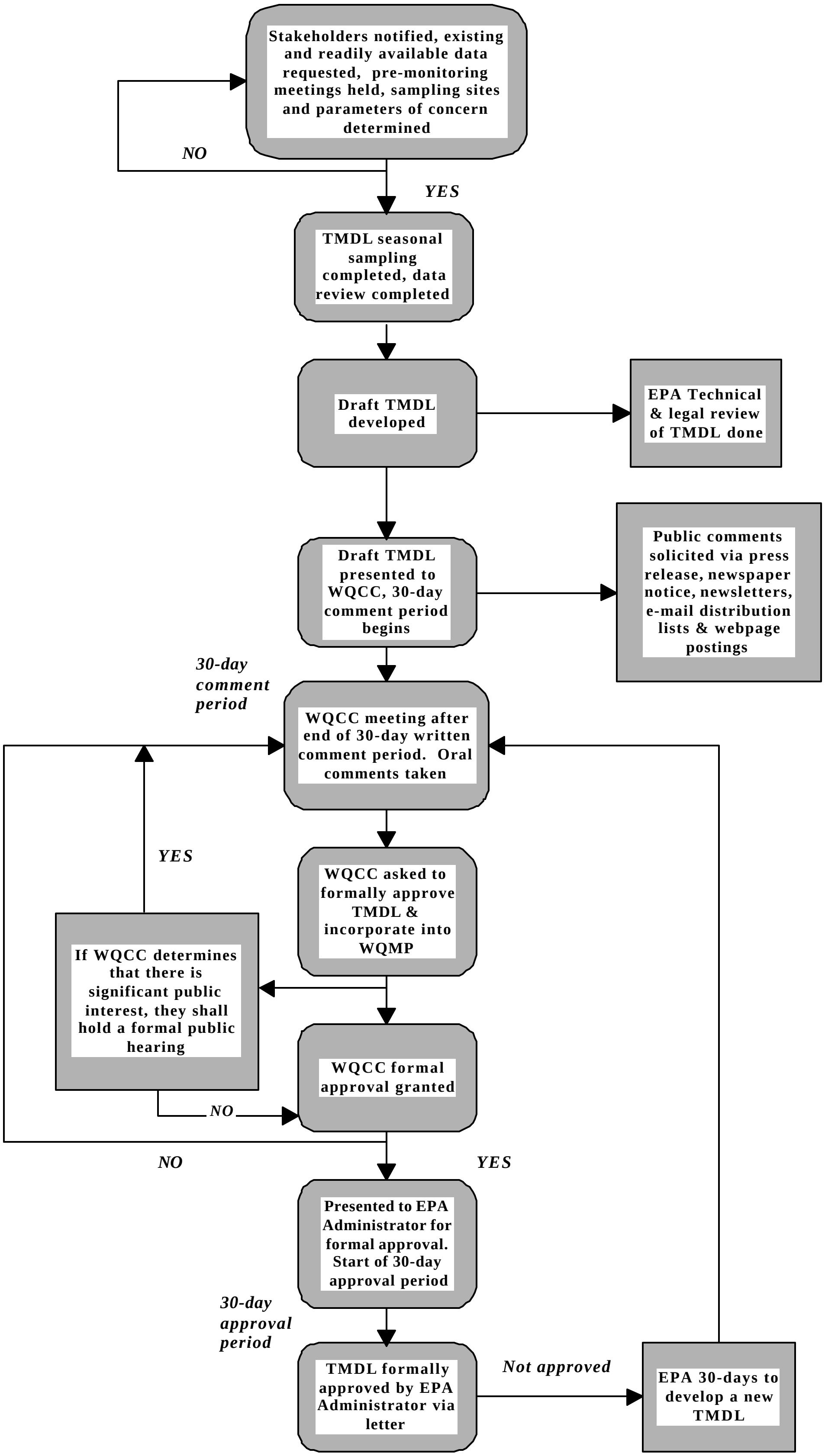
CODES FOR SOURCES OF NONSUPPORT (CHECK ALL THAT APPLY)

- ☐ 0100 <u>INDUSTRIAL POINT SOURCES</u>
- ☐ 0200 <u>MUNICIPAL POINT SOURCES</u>
- ☐ 0201 DOMESTIC POINT SOURCES
- ☐ 0400 <u>COMBINED SEWER OVERFLOWS</u>
- ☐ 1000 <u>AGRICULTURE</u>
- ☐ 1100 NONIRRIGATED CROP PRODUCTION
- ☐ 1200 IRRIGATED CROP PRODUCTION
- ☐ 1201 IRRIGATED RETURN FLOWS
- ☐ 1300 SPECIALTY CROP PRODUCTION (e.g., truck farming and orchards)
- ☐ 1400 PASTURELAND
- ☐ 1500 RANGELAND
- ☐ 1600 FEEDLOTS - ALL TYPES
- ☐ 1700 AQUACULTURE
- ☐ 1800 ANIMAL HOLDING/MANAGEMENT AREAS
- ☐ 1900 MANURE LAGOONS
- ☐ 2000 <u>SILVICULTURE</u>
- ☐ 2100 HARVESTING, RESTORATION, RESIDUE MANAGEMENT
- ☐ 2200 FOREST MANAGEMENT
- ☐ 2300 ROAD CONSTRUCTION or MAINTENANCE
- ☐ 3000 <u>CONSTRUCTION</u>
- ☐ 3100 HIGHWAY/ROAD/BRIDGE
- ☐ 3200 LAND DEVELOPMENT
- ☐ 3201 RESORT DEVELOPMENT
- ☐ 3300 HYDROELECTRIC

- ☐ 4000 <u>URBAN RUNOFF/STORM SEWERS</u>
- ☐ 5000 <u>RESOURCES EXTRACTION</u>
- ☐ 5100 SURFACE MINING
- ☐ 5200 SUBSURFACE MINING
- ☐ 5300 PLACER MINING
- ☐ 5400 DREDGE MINING
- ☐ 5500 PETROLEUM ACTIVITIES
- ☐ 5501 PIPELINES
- ☐ 5600 MILL TAILINGS
- ☐ 5700 MINE TAILINGS
- ☐ 5800 ROAD CONSTRUCTION/MAINTENANCE 8400
- ☐ 5900 SPILLS
- ☐ 6000 <u>LAND DISPOSAL</u>
- ☐ 6100 SLUDGE
- ☐ 6200 WASTEWATER
- ☐ 6300 LANDFILLS
- ☐ 6400 INDUSTRIAL LAND TREATMENT
- ☐ 6500 ONSITE WASTEWATER SYSTEMS (septic tanks, etc.)
- ☐ 6600 HAZARDOUS WASTE
- ☐ 6700 SEPTAGE DISPOSAL
- ☐ 6800 UST LEAKS
- ☐ 7000 <u>HYDROMODIFICATION</u>
- ☐ 7100 CHANNELIZATION
- ☐ 7200 DREDGING
- ☐ 7300 DAM CONSTRUCTION/REPAIR

- ☐ 7400 FLOW REGULATION/MODIFICATION
- ☐ 7500 BRIDGE CONSTRUCTION
- ☐ 7600 REMOVAL OF RIPARIAN VEGETATION
- ☐ 7700 STREAMBANK MODIFICATION OR DESTABILIZATION
- ☐ 7800 DRAINING/FILLING OF WETLANDS
- ☐ 8000 <u>OTHER</u>
- ☐ 8010 VECTOR CONTROL ACTIVITIES
- ☐ 8100 ATMOSPHERIC DEPOSITION
- ☐ 8200 WASTE STORAGE/STORAGE TANK LEAKS
- ☐ 8300 ROAD MAINTENANCE or RUNOFF
- ☐ 8400 SPILLS
- ☐ 8500 IN-PLACE CONTAMINANTS
- ☐ 8600 NATURAL
- ☐ 8700 RECREATIONAL ACTIVITIES
- ☐ 8701 ROAD/PARKING LOT RUNOFF
- ☐ 8702 OFF-ROAD VEHICLES
- ☐ 8703 REFUSE DISPOSAL
- ☐ 8704 WILDLIFE IMPACTS
- ☐ 8705 SKI SLOPE RUNOFF
- ☐ 8800 UPSTREAM IMPOUNDMENT
- ☐ 8900 SALT STORAGE SITES
- ☐ 9000 <u>SOURCE UNKNOWN</u>

Appendix H: Public Participation Flowchart



Appendix I: Response to Comments

To be completed later.